INDEXED.

International Marine Engineering

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SIDE-WHEEL FERRYBOAT SAN PEDRO.

The *San Pedro* is a steel double-ended side-wheel ferryboat owned by the Atchison, Topeka & Santa Fe Railway Company, built by the Union Iron Works Company in San Francisco, Cal., under the supervision of Robert Forsyth, consulting engineer, 1020 Merchants' Exchange, San Francisco. The contract for the vessel was let April 27, 1910; she was launched Feb. 1, 1911, and went into commission May 15, 1911. The *San Pedro* connects the Atchison, Topeka & Santa Fe Railway system at its terminal, "Point Richmond," with the ferry depot at foot of Market street, San Francisco, a distance of about 7 miles, and is fitted up for the conveyance of passengers, baggage, mail and express matter. The dimensions of the boat are as follows:

NEW SIDE-WHEEL FERRYBOAT FOR PASSENGER, BAGGAGE, MAIL AND EXPRESS SERVICE.

Length over guards	259 ft. 6 ins.
Length outside of rudder posts	248 ft. 6 ins.
Beam molded	36 ft. 0 ins.
Beam over guards	64 ft. 0 ins.
Depth molded at side mid-length	18 ft. 0 ins.
Depth molded at center mid-length	18 ft. 6 ins.
Displacement	1,353 tons.
Total number of passenger seats	782

The vessel is divided into compartments by seven bulkheads, as follows: Two peak tanks to carry fresh water, two holds, one compartment with fuel oil tanks in hold and restaurant with kitchen 'tween decks, one compartment with fuel oil tank in hold and crew's living quarters in 'tween decks, one compartment for engines and one compartment for boilers.

The main deck has through passage for teams and seats for 168 passengers. It has entrances to holds, restaurant and living quarters of the crew, which are below the main deck; also steel enclosures to the machinery and boiler spaces. Men's toilet rooms are located on each side of the vessel, with crew's wash room, lamp room, mates' store rooms, room for steward and a bar room. Steam steering engines are on this deck directly under each pilot house; a combined hand and steam capstan is on each end of the vessel on this deck outside of the deck house.

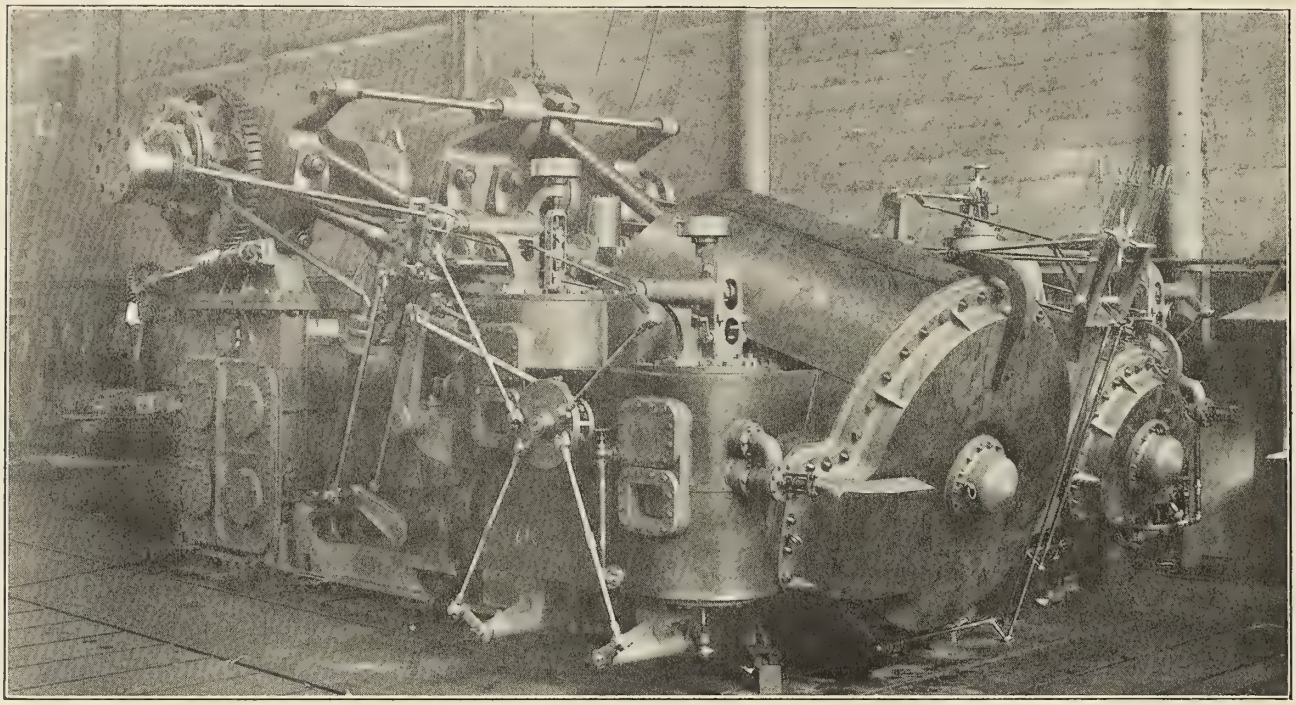
The upper deck is reached by two corner stairways at each end of the deck house. Entrance to the saloon is through two large sliding doors. The saloon is enclosed for 96 feet in length, the middle portion is enclosed out to the side. The floor is covered with magnesite composition of a terra-cotta color matching with the mahogany of the seat, and is well filleted at outer edges, giving a very sanitary floor. The toilet room for ladies is on this deck. Seats outside are provided for about 180 passengers at each end; a longitudinal bulkhead, well glazed, gives the required protection to passengers who prefer the open air.

The amidship part of the saloon has a dome of 98 feet by 31 feet, rising vertically at sides about 28 feet, where it is fitted with art glass. The roof is formed by pleasing double curves, giving an airy, roomy and pleasing appearance to the whole. The finish of the saloon is white with a little carving touched with gold, mahogany polished seats and window sashes, and the floor, toning well with mahogany, gives a very attractive appearance.

On each end of the hurricane deck is placed a pilot house, 12 feet by 12 feet, fitted with steam and hand-steering gear, telegraphs, electric call bells and speaking tubes to the engine-room, electric call alarms to crew's quarters and main deck, electric communication between each pilot house, and speaking tubes to the main deck, whistle pulls, searchlight controller, engine revolution tell-tale, and a switchboard specially arranged to cut off any lights that may interfere with the vision of the navigator.

Immediately adjoining the pilot house are the officers' rooms.

The machinery of the *San Pedro* is as follows:



DIAGONAL COMPOUND ENGINE OF THE SAN PEDRO, SHOWING THE ARRANGEMENT OF VALVES.

Diagonal compound engine	38″ — 77″x 66″ stroke
Indicated horsepower	2,000
Condensing surface	4,000 sq. ft.
Feathering wheels diameter to center of floats	16′ 0″
Size of floats	10″ x 3′ 6″
Number of floats	8
Babcock & Wilcox water-tube boilers	4
Total heating surface	9,332 sq. ft.
Working pressure	150 lbs. per sq. in.
Fitted to burn oil fuel.	
Circulating pump engine (runner 12″)	10″ x 10″
Reversing engine	7″ x 22½″
Turning engine	7″ — 7″ x 6″
Two electric light engines, 25-K. W. generator, from General Electric Company	9½″ x 8″
Two steam capstans	7″ — 7″ x 8″
Two steam steering engines	8″ — 8″ x 8″
One Dow air pump, walking-beam type	20″ dia., air 12″ dia., steam 12″ stroke
Two Dow fresh-water feed pumps	10″ — 6″ x 18″
Two Dow fresh-water feed pumps, horizontal duplex, with automatic control	3″ — 3″ x 3″
One Dow fire and bilge pump, vertical	12″ — 10″ x 12″
One Dow sanitary pump, vertical, with automatic control	6½″ x 6″ x 10″
Two Dow oil pumps, horizontal duplex, with automatic control	6″ — 5″ x 10″
One Metropolitan injector for boiler feed	2″
Six ejectors for draining bilges	1½″
One feed-water heater, with 400 sq. ft. of heating surface	1″ x 8′ 0″ copper tubes
One feed and filter tank.	
One steam separator in engine room	3′ x 9′

All steam pipes, feed pipes and sea connections are of copper. Auxiliary exhaust, bilge, fire main and fuel oil pipes are of galvanized iron.

The main engines are fitted with poppett valves operated through the usual Stevenson reversing links, the admission valves having the cut-off trip operated by a third eccentric, while the variable adjustment of the cut-off point is conveniently controlled by levers on the working platform. The whole arrangement is very satisfactory and suitable for ferry service where prompt reversals are necessary. Oil fuel tanks have a total capacity of 10,000 gallons.

The *San Pedro* is a highly satisfactory ferry, very complete, very pleasing to travel upon, and makes quite an attractive addition to the already great equipment of the Santa Fe Railway system.

Mr. Henry M. Seeley has been appointed steamboat inspector for the port of New York.

Curtis Marine Steam Turbines for the Italian Scout Cruisers Nino Bixio and Marsala.

The Fore River Shipbuilding Company, at Quincy, Mass., has just shipped from its works to the Officine Meccaniche, Naples, Italy, three of six Curtis turbines for the Italian cruisers *Nino Bixio* and *Marsala.* The turbines were loaded at Quincy on the lighter *Commissioner* of the Merritt & Chapman fleet and taken to New York, where they were shipped on the steamer *Perugia,* sailing July 22 for Naples.

Each of the vessels for which this machinery was built has three turbines, each driving a single screw, one on the center line of the ship and two at the sides, as in ordinary twin-screw arrangement. The turbines at 450 revolutions will develop 8,000 horsepower each, and 22,500 horsepower will give the vessels a speed of 28 knots.

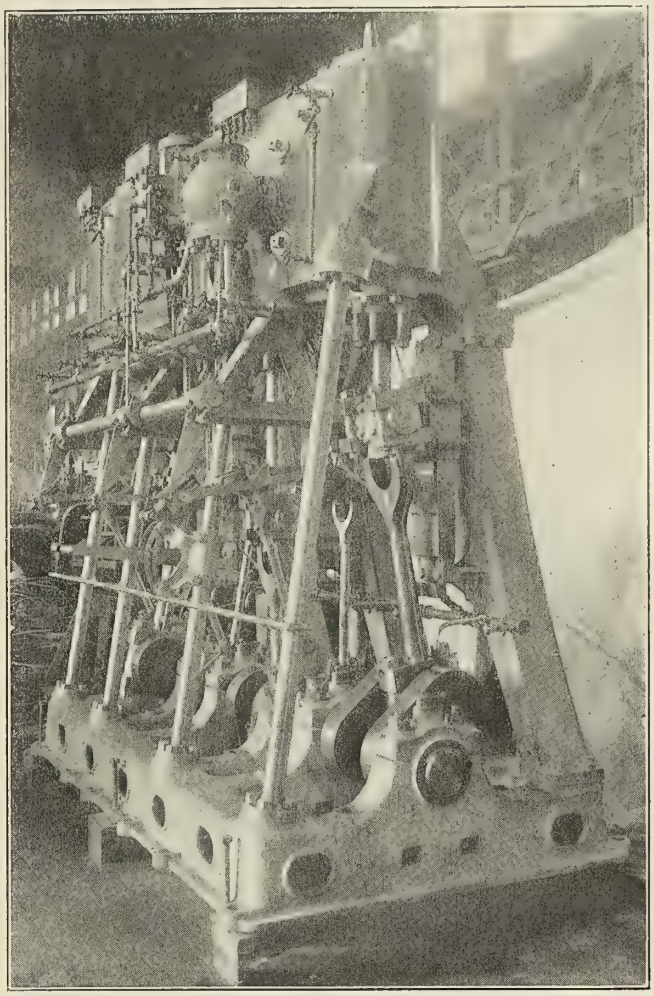
The turbines are technically called 80-inch 16-stage turbines; that is, the mean diameter of the rotating drum is 80 inches, and the steam is expanded sixteen times from boiler to condenser. The turbines are extremely simple in construction, no part being in motion except the one main revolving shaft, with its wheels and buckets inside the casing. On the shaft are a series of wheels and a drum carrying at the periphery rows of buckets on which the steam impinges as it passes through from boiler to the condenser. Between each row of revolving buckets are stationary guide buckets, rigidly fixed to the interior of the casing for the purpose of guiding and giving the proper direction to the steam before it impinges on the revolving blades. There is also a series of nozzles disposed between the various stages, with openings so designed as to control the velocity and pressures of the steam in its flow from stage to stage, in such manner that the entire energy of the steam is gradually utilized and absorbed in turning effort as it passes through the turbine from end to end.

For reversing there are wheels with several rows of buckets and nozzles, formed exactly as those just described but with the angle of buckets in the opposite direction, all within the same casing. These wheels are located at the exhaust end of the turbine, and therefore when going ahead simply revolve idly in vacuum. When backing, steam is shut off from the

head end and turned into the astern end, passing through these reverse buckets, reversing the motion, the turbine shaft turning in the opposite direction and the ahead wheels and drum revolving idly in vacuum.

The thrust of the propeller is taken directly by steam pressure on the end of the drum itself, thus practically eliminating friction. There is a thrust bearing formed directly on the end of the turbine casing to take up the inequalities of thrust, the entire design resulting in one complete self-contained structure.

Each turbine when completed was connected to the test boiler and condenser, run and tested in the shop before shipment. The turbines were fitted complete with valves, piping and fitting for operating, and for drainage and lubrication, etc. The total weight of each turbine was 100,000 pounds, the outside dimensions being 21 feet 6 inches long and 9 feet 4 inches in width.



ONE OF THE MAIN ENGINES FOR THE SOUTHPORT AND WESTPORT.

STEAMERS SOUTHPORT AND WESTPORT.

The Eastern Steamship Company's new boats, *Southport* and *Westport,* were built by William McKie, of East Boston, Mass. Both of these vessels are to be used on the Boothbay division for freight and passenger traffic.

The general view of this vessel shows a ship-shape-looking product. The general dimensions are:

Length between perpendiculars.....	131 feet 5 inches.
Length over all.....	138 feet.
Molded beam at waterline.....	20 feet 6 inches.
Beam outside of guards.....	29 feet.
Depth amidships top of floor to top of deck beam.....	9 feet.
Draft forward, loaded.....	4 feet 6 inches.
Draft aft. loaded.....	8 feet.
Timber construction.....	

The engines were built at the Atlantic Works, East Boston, and are triple-expansion, with cylinders 10½ inches, 17½ inches and 28 inches, with a stroke of 18 inches. They run at 200 revolutions per minute. A glance at the illustration will show the design. Each engine is fitted with piston valves on the high-pressure also on the intermediate and low-pressure cylinders. Stevenson link motion is used, also steam reversing gear. Taylor watertube boilers furnish steam at 150 pounds Each boiler has a grate surface of 58 square feet and a heating surface of 2,150 square feet. The pumps and condensers are all independent. The circulating pump is of the centrifugal type. The boiler feed pump is controlled by means of a float in the filter box. The air pump is of the single-cylinder double-acting type. This has the advantage of light weight and occupying small space.

On her trial trip the *Southport* made an average of 1½ miles over the contract speed of 14 miles per hour. We understand

ONE OF THE NEW STEAMERS BUILT FOR THE BOOTHBAY DIVISION OF THE EASTERN STEAMSHIP COMPANY.

that the *Westport* did equally as well, showing the excellence of the design.

Special attention is called to the overhang, as shown in the thwartship section. The sponsons were built out 4 feet with special construction. This method of building the sponsons and strengthening them is unusual, and is one of the important features of these boats.

The combination hand and steam steering engines were built by Williamson Bros., of Philadelphia, and the capstan-windlasses were furnished by the Hyde Windlass Company, Bath, Me.

The boats are lighted by electicity, the electric outfits being supplied by the Sturtevant Company, Hyde Park, Mass.

RECAPITULATION OF REPORTS OF TRIALS WITH ANTI-ROLLING TANKS AT SEA.*

With the increased size of the transatlantic steamers one would be led to surmise that the question of sea sickness would not be as serious a subject as in days gone by. Yet anyone who has ever been afflicted with that always ludicrous but frightfully uncomfortable sensation will admit that anything which could prevent it would be received most gratefully by the traveling public.

The efforts that have been made to use an anti-rolling device date back a considerable time. The old *Inflexible* in the early 80's was experimented with, and, if we remember right, several later attempts were made to use the idea of employing free water to prevent the rolling of a ship. Lately Herr Frahm has given accounts of experiments made which seemed to prove very satisfactory. Diagrams taken show a decided gain in the stability of a ship's deck with the anti-rolling tanks as applied to the steamship *Ypiranga.* Undoubtedly such experiments if they prove successful, as they evidently have, would point towards a more stable platform for guns, and consequently the navy would be greatly interested in this set of experiments; and the transatlantic liners seem to have taken up the subject with the hope of decreasing the uncomfortable sensation of sea sickness.

Many conditions must enter into the application of these tanks. "Practically the midship position (we are quoting from Herr Frahm's paper) will be always preferred, because it is the broadest part of the vessel, and besides the yawing of the ship, *i. e.,* lateral sheering under the impetus of cross seas, is less evident here. These sheering motions may possibly diminish the efficiency of the tank by accelerating the movement of the water obtained in cross connection; but this is only likely to happen in a stiff vessel with a high period of frequency, which consequently requires the cross communication to be rather wide. On normal vessels, *i. e.,* not too stiff, the tank may be well placed fore and aft. Instead of only one large tank two or more smaller ones may be employed, placed in different parts of the ship. As to the height above the waterline, no general rule can be established. The best efficiency will be obtained by placing the cross connection above the center of gravity. In this case the hydrodynamical action of the water in the connection will increase the statical action of the side tanks. On the other hand, it would be quite possible to place the connections below the center if the tank can be enlarged accordingly. This increase in size will be small in ships with slow periods, but more important in a stiff vessel with comparatively short periods."

It seems that this question of anti-rolling tanks is being taken up with great interest by British builders, and that several vessels are under construction so fitted. The report is that in one case, in the Bay of Biscay, the steamship *General* was rolling 14 degrees on either side when the tanks were out of action. Then the following experiments were made: (*a*) The smaller fore and aft tank, which was fitted forward, was put in action, with the result that the heeling angles were at once reduced to from 7 to 8 degrees, or practically a reduction of 50 percent. When the after tank, which was a large one, was put in action, the rolling was reduced to 3 degrees in either direction. This certainly shows a most decided gain.

It is asserted in this same article that by calculation it is quite possible to build passenger ships, with the usual high superstructure, up to 130 feet beam, with a draft of 34 to 36 feet, which with the aid of the anti-rolling device will be perfectly steady, the necessary water required being only 1.3 percent to 1.1 percent of the displacement. This, it is claimed, will decrease the traverse stress in the hulls, and improve the steering and maneuvering qualities of the ship, and prevent loss in speed in unfavorable seas.

It is further stated, and this we consider a very great point, that this system of anti-rolling tanks can be fitted without great additional cost into existing ships, which undoubtedly would add to their sea-going qualities. Further improvements are also hinted at, which, of course, would be welcome, and for men-of-war they would be particularly advantageous, as they would dispense with the cross connection. In this arrangement the wing tanks, though specially shaped, and the dimensioned holes in the shell plating have direct communication with the sea. With this form of tank, which in model experiments has given good results, further information will be given, and it is understood that the system will be tried on a large scale very shortly.

In the article from the *Engineer* referred to, Professor Biles asserts that the credit for the use of these tanks belongs to Sir Philip Watts, although since his time great progress has been made, and it was he who first fitted them, we understand, to the *Inflexible.*

It is interesting to note that Sir William White says that the reasons why the system was given up after the trials with the *Edinburgh* and *Colossus* were twofold: "First, the noise and shock on the under side of the deck upon which was the living space, and, secondly, that these ships did not roll heavily under average conditions."

It is rather interesting to note that failures of the past are being made successes of the present in a number of cases, and here certainly is one which illustrates the fact most clearly.

*Abstract from a paper at the Institute of Naval Architects.

Oil Engines and Thermal Efficiency.

While it would be about as erroneous to recommend an engine on its thermal efficiency alone as to entirely disregard it, the fact that the engines with the highest thermal efficiency to-day are in the great minority seems at first thought a peculiar state of affairs. But a careful analysis of all the advantages and disadvantages of each type would show that the general practice is justified.

Credited with a thermal efficiency varying from 38 to 42 percent, the Diesel engine is in this respect ahead of any other internal-combustion motor or gas engine, turbine or reciprocating engine, but its comparatively high cost and maintenance, together with the care necessary for its operation, have stood in the way of its general adoption. Though less efficient, the other types of engines have flourished because they have been produced at a reasonable figure and have comparatively low maintenance charges.

In their desire to produce a successful commercial oil engine, manufacturers have generally not sufficiently considered the most important factor in obtaining the high Diesel efficiency, *i. e.,* compression. As a result the average oil engine is a low-compression engine.

With the low cost of kerosene (paraffin) and the distillate oils, together with the increasing cost of gasoline (petrol) of poor quality, the possibilities of an improved design of oil engine are many.

It is understood that an oil engine approximating the fuel economy of the Diesel has recently been produced. It is claimed that it incurs a comparatively small up-keep expense, and the selling price per horsepower installed is reasonable. This engine uses a compression somewhat higher than usual, atomizing the fuel mechanically without an air compressor. The results of any tests on these oil engines will certainly prove of decided interest.

GAS ENGINES; THEIR DESIGN AND APPLICATION.

BY E. N. PERCY.

The design of a gas engine is determined partly by the conditions under which it is to operate, partly by limits of facilities of manufacture and very much by the ideas of the local market as to what a gas engine should be like, regardless of correct design. In connection with this it is quite frequent that one finds a local market demanding an open type engine, another with an enclosed crank case. The first may demand solid head engines and the second separate head engines. One market may demand multiple cylinders cast in one piece and the other single cylinders, there being no overwhelming advantages, so far as the writer can see, in favor of any one of these designs but many arguments both for and against same.

Of the technical conditions determining the engine design the more important are amount of fuel to be used, purpose for which the engine is intended, space available, limits of weight, importance of economy, importance of wearing qualities and limits of cost.

FUELS.

Fuels may be summed up generally in two classes: liquids and gases; solid fuels not being as yet directly available for internal combustion engines. Among the liquid fuels might be mentioned crude petroleum and its various products, alcohol and ether. Among the gaseous fuels, or fuels which may be converted into gas, may be mentioned coal, coke, oil residuals and heavy hydrocarbons. In fact any organic substance whatever may be converted into combustible gases by proper treatment, with the allowance and acknowledgment of the fact that this department of engineering is as yet not fully developed.

The first two conditions overtop and determine all the others; the other, in fact, being dependent on fuel and the purpose to which the engine is destined. At this stage of very rapid progress made in the gas engine world, the principal fuels are the various well-known products of crude oil, although gas producers for solid fuels are becoming more and more a recognized factor of the industry.

Oil.—The two greatest classes into which oils divide themselves, so far as the gas engine man is interested, are asphaltum base and paraffin base. The words paraffin base and asphaltum base refer to the hydrocarbon series of which the oil is composed. In paraffin base oils there is less residual and heavy hydrocarbon than in the asphaltum base oil. The asphaltum base oil contains very largely all heavy hydrocarbons of the lower series in which there is a very large proportion of carbon as compared to the hydrogen (*i. e.*, bitumen, pitch, tar, etc.). These compounds, after being heated and after having dissociated the lower constituents, seem very readily, when exposed to severe heat, to change their chemical form, so that a lighter hydrocarbon is given off and pure carbon or even a heavier hydrocarbon remains. This is what happens in all attempts to use crude oil directly in the cylinders of internal combustion engines. That type of engine which seems to have got the nearest to solving this problem has admitted water to the engine cylinders in one form or another, the real result being to break the water up into these compound gases, thus providing more hydrogen for the heavy hydrocarbon; both being in a nascent condition, under the influence of the extreme temperatures they combine and form a lighter and more volatile hydrocarbon, or the hydrogen combines with the free carbon deposit from the heavy hydrocarbon, both forming a lighter hydrocarbon subject to the action of oxygen in the usual manner. However, even this type of engine is only partially successful, inasmuch as it can only make use of certain kinds of crude oil, it being impossible to use any crude oil having foreign material, or even any great amounts of heavy hydrocarbon in suspension, because, in the first place the foreign material makes clinker particles which score the cylinder; second, the heavy hydrocarbons are more or less in suspension and, as solid or highly viscous masses, cannot be sufficiently separated or subdivided by any known method to effect complete combustion, the result being heavy deposits in the cylinders; furthermore, if these same hydrocarbons be subjected to heat in any considerable degree before entering the engine cylinders, it will only result in heavy deposits of carbon or hydrocarbon.

Crude petroleum as it comes from the well is a very complicated substance, and the first physical feature to be taken care of is the sediment which settles from the petroleum. This is usually taken care of at the well and need never be looked out for by the consumer. All the various products of petroleum, benzine, gasoline (petrol) and naptha have a flash point below 73 degrees F., meaning that they have to be heated to more than this temperature to obtain ignition from a match, electric spark or other source. Next come the illuminating oils, such as kerosene (paraffin), white rose and other effervescents, having a flash point of approximately 150 degrees and more than 73 degrees. The next product is gaseous oil or fuel oil, usually used for gas making and also for internal combustion engines. These oils have a flash point of 190 degrees.

Gasolene (petrol), as classified by the Standard Oil Company, has a specific gravity of 76. It is the most common fuel used for small internal combustion engines. It carburets usually at ordinary temperatures, is volatile, yet not so much so as to make it uncontrollable; while its heat value is less than that of the heavier hydrocarbons it is more cleanly and more highly standardized. On account of its volatility it is more dangerous than the heavier hydrocarbons, and every precaution should be taken when handling it.

Alcohol has many of the carbureting characteristics of kerosene (paraffin) and its distillates, and when used under proper conditions with heated air or heated carburetors it is a useful and cleanly fuel and much safer than gasoline (petrol).

The use of any liquid fuel in vaporizing carburetors of hydrocarbon engines, either by injection or carburetion, is limited; first, because only comparatively highly-priced fuels can be used, and second, because the tendency to pre-ignite with the heat of compression prevents the use of such economy as might result from having a high compression. It should be explained at this point that the hydrocarbons and their vapors in themselves do not have a tendency to pre-ignite more easily than the principal gases from producers or other sources, but with liquids or vapors it is not possible to furnish readily and continually a mixture weak enough to be perfectly safe under conditions of high compression, whereas with weak producer gases and gas where the calorific value is not too high it is easily possible to maintain a weak economic mixture capable of standing high compression without pre-ignition; in fact, with weak producer gas and proper design it would not be possible to have a dangerous pre-ignition. With carbureted vapors, or the spray of liquidated hydrocarbons, it is possible to pack into a cylinder of an engine so great an amount of fuel that the heat generated from an explosion can be quite dangerous if the compression is too high.

On the other hand, with a gaseous fuel, the volume occupied is so great that it becomes a real problem to get sufficient fuel into the cylinder to maintain an equal amount of power; as a matter of fact, a given size engine operating at a definite speed will give about 20 percent less power than with the vapor or spray of liquid hydrocarbon. Furthermore, the gaseous fuels prove somewhat slower than the vapors, requiring a longer stroke, less piston speed and an additional time.

Hence, from the above facts, it is a simple deduction that for large economical power we must look to the gas and not to the liquid hydrocarbon engine. It is probable that this engine will be of a little slower speed and somewhat heavier than the engines in use to-day, but, at the same time, it is hardly likely that it will resemble the ponderous engines used in Germany and in some parts of America.

Gases.—In general, so far as the gas engineer is concerned, gases will divide themselves into two classes, weak gases and strong gases. Among the strong gases are the natural gases, as fine illuminating gases, acetylene, water gas and gases especially made by retort methods. In general, these are either hydrocarbon gases or carbon in composition with some element other than oxygen. These gases may run 500 British thermal units per cubic foot; some run slower. Weak gases include producer gas, blast furnace gas by process of coke ovens, waste products of gas works, metallurgical furnaces and other less common sources. These gases run from 100 to 125 British thermal units per cubic foot and are more or less diluted with inert gases or non-heat producing gases. All of the strong gases, when considered as fuel for large engines, are expensive and impractical either because, as in the case of natural gas, they are confined to a locality or because the processes for making are cumbersome, or because so much of the heat value is driven away in by-products in the form of coke, tar, etc., thus eliminating them from further consideration as fuels for gas engines on a large scale. Of the strong and weak gases it has been practically proved that the weaker gases are both thermally and commercially more efficient than the strong gases. It is understood that this efficiency includes the thermal and commercial efficiency of the plant manufacturing them. Of the weaker gases blast furnace, coke-oven by-products are confined to particular localities and are valuable fuels when they can be procured and can be used successfully in any producer gas engine, with slight changes; hence we will consider all gas engines in their relation to the gas producer exclusively and local hydrocarbon engines in their relation to gasolene (petrol), kerosene (paraffin), and the distillates only.

GENERAL AND COMPARATIVE FEATURES OF DESIGN.

For a description of each of the many gas engines in common use and for a history of the industry, the writer refers to Grover, Donkin, Clerk, Methot and others.

Of the various cycles in use the most predominating one is the four-cycle, four-stroke engine taking in a charge of fuel and air mixed, vaporized by the engine, but exploding same within the cylinder after combustion and ignition. Ranking next in popularity is probably the injection type, which, from the nature of its cycle, is confined to liquid fuels, these being sprayed directly into the cylinder by various methods. Special types of this cylinder include the Diesel, which compresses to 800 pounds or more, igniting its charge by the heat of compression, the jet of oil being cut off by the governor at various points in proportion to the load carried. Other injection engines ignite with hot tube or incandescent globe or flame.

The two-cycle engine is made in many forms, the aim being to obtain an explosion at every revolution. As all injection engines other than the Diesel are confined to the lighter distillates, they cannot be seriously considered in connection with large powers of the future because of the prohibitive cost of distillate in any form.

Two-cycle engines, as at present constructed, are inefficient mechanically because of wide ports, piston rings that are not tight and faulty lubrication. They are uneconomical because of fuel leakage and mixture of fuel with the out-going air. The present accepted type of engine of any cycle for ordinary purposes is of the vertical or horizontal design, with trunk piston, internal piston pin and single-acting cylinder. There may be one or more cylinders governed by much the same conditions as in the steam engines, the best practice calling invariably for the four-cycle, four-stroke type; a little more advanced type of engine equally successful in every way is found with a double-acting cylinder exploding on both ends. This type may now be found doing good service in all parts of the engineering world. For power purposes these cylinders are usually arranged tandem throughout; two, three or four in a row connected up by the very heaviest construction, the details of which will be considered later.

The lighter vertical, high-speed type of the double-acting engine is also built. Both of these types resemble steam engines very much, inasmuch as they are double-acting, having cross-head with all moving parts in full view, there being no external leakage of gas, smoke or odors, and the external moving parts are lubricated in a clean manner without the usual leakage of oil or soot from above. It is quite probable that the gas engine of the near future will follow mechanically along the design long ago found most practical through steam-engine practice, the double-acting engine giving twice the power for practically the same weight of material, and the cost and fuel consumption being less than for two engines of the single-acting type and being more economical because the cylinder walls are hotter at the ends of the expansion stroke.

There is no doubt but that new cycles are not only possible, but probably will soon be recognized. In connection with this reference should be made to the able paper, Evolution of Internal Combustion Engines, by Prof. Reeve, published in the Transactions of the A. S. M. E., in December, 1907. In this paper are ably shown the thermal dynamic possibilities of several possible cycles, including the outside compression type of engine, in which the fuel may be burned either within the cylinder of the engine or between the compressor and the engine. In this valuable paper are given further the proper sizes of compressors and engines for various specified conditions which are quoted in Table 1.

Prof. Reeve notes in connection with his various calculations that for an outside compression cycle with combustion between the two cylinders under the normal conditions of operation about four-tenths of the gross power developed would be necessary to operate the compressor. It is doubtful whether much less than this amount of power is consumed by the horizontal four-cycle engine when all things are taken into consideration. Assuming that the engine was supposed to develop from 160 to 200 horsepower, and that the compressor's resistance was about 67 horsepower, the table shows the various net horsepower delivered for the various powers developed. This valuable paper gives much more information in relation to the ratios between compression and explosion for the various cycles and the probable losses for various prospective cycles.

TABLE 1.

Motor's Power.	Compressor's Resistance.	Net Power Delivered to Shaft.
Horsepower.	Horsepower.	Horsepower and Percent of Rating.
200	67	133
167	67	100
133	67	66
100	67	33
67	67	0
33	67	—34
0	67	—67

It is not the purpose to make any profound study of thermodynamics; still, it is advisable to point out in a practical way the limitations of the various cycles. In the first place, all known objects, conditions, states and elements have two factors through which we study them; the first being their quantity, amount or mass; the second being their state, tension or pressure. Thus in a solid object we have mass and density. With electricity, which is a condition, we have amperage, measuring the amount or mass of that condition, and voltage, measuring its tension and pressure.

Heat being also a condition instead of a substance, we measure its tension or temperature in degrees, and the mass or amount in British thermal units or other suitable unit. Temperature is a familiar term, but the amount or mass of heat is something to which particular attention must be paid; for instance, despite the tremendous temperatures of the gases during and after explosion in a gas engine cylinder, they will collapse, as noted by Prof. Reeve, when introduced into a second cylinder for the purpose of compounding. In fact, it is almost impossible to remove these gases from any chamber into which they are exploded by any practical means because of their immediate collapse, and yet steam, at a much lower temperature, may be led into two, three, four and five cylinders successively, doing its work there and retain energy.

Simple calculations, based upon the well-known properties of steam on the one hand and upon the amount and calorific value of the fuel in the gas engine on the other hand, will show that with the cylinder first filled with gas and secondly filled with steam for the space of one stroke, the usual amount of heat escaping from the gas into the water jacket, the steam will have more heat value than the body of gas. The reason for this is that the heat of the steam has breadth or mass; while the heat of the gas has only height or temperature. It is a common thought for the non-scientific engineer that the latent heat of water to steam is lost, an idea which is entirely erroneous, as this heat, while not expressed in temperature, is expressed as mass or entropy measured in British thermal units, and gives the steam the power to expand without collapsing. Hence we can easily deduct that it is impossible to invent any cycle in which combustion or expansion do not take place in the same chamber, unless some means are adopted whereby the temperature of the gases may be reduced and their heat mass expanded in the same proportion. The advantages will be, first, less loss because there would be less difference in temperature between the gases and the walls confining them; second, it would in all probability be possible to reduce the gas to such a temperature that it would not be necessary to cool the walls of the expanding cylinder; third, as the heat mass of the gas body is increased it would be possible to lead it through two or more cylinders for expansion or even through a gas turbine.

A practical objection in connection with new cycles, or the outside compression type of engine, is the enormous compressor required.

With the gas engine, as with all other machinery, the most valuable feature of its existence is practical development, the theory always being far in advance of the actual commercial development; an engine of any cycle or design being a really valuable machine only when it has eliminated the usual troubles of an experimental engine. This being of primary importance, we come to the secondary considerations of economy and technically correct design.

After settling upon the horsepower of an engine the next decision must be the bore and stroke. These bear various proportions to each other and to the horsepower depending upon the piston speed, revolutions per minute, type of engine, compression, wearing qualities, pressure generated and temperature. The piston speed varies widely and may be taken in general as follows:

	Feet per Minute.
Automobile engines	600 to 1,000
High-speed motor boat and light two-cycle engines	600 to 800
Heavy marine engines of the latest practice for tugboat and heavy work, less than 100 horsepower	400 to 600
Marine engines of the heaviest type, 100 to 1,000 horsepower	300 to 500
Commercial horizontal stationary engines	400 to 700
Stationary horizontal engines of the most solid and conservative type of several hundred horsepower or more, three, four and five stroke	600 to 900

Piston speed considered separately from reciprocation is purely a matter of lubrication, and with proper cooling, improved lubrication apparatus, etc., these values may be greatly exceeded, but they represent present practice.

The relation of power and stroke to each other is dependent upon revolutions per minute, combustion and fuel used.

Liquid hydrocarbons and the strong gases being quicker burning and more easily ignited require shorter stroke, less combustion and more revolutions. The weak gases being slower burning and less easily ignited require longer stroke, greater combustion and a less number of revolutions. Thus, in regard to bore and stroke the engines may be divided into two classes, the quick-running hydrocarbon engines and the slow-running gas engines. Of the various engines we have the following table, showing ratios of bore to stroke:

TABLE 2.

Style of Engine.	Bore.	Stroke.
Automobile	1	1
Commercial gasoline and oil	1	$1\frac{1}{2}$ to $1\frac{5}{8}$
Heavy gas engines	1	2 to 4

Having approximated the piston speed and the ratio between bore and stroke, and having decided upon the type of engine, its wearing qualities, whether it is to be high or low speed, and so forth, the horsepower and compression must be settled upon simultaneously. For purposes of design, the strain which the maximum compression generates usually is taken at three and one-half times the maximum compression pressure.

In the design of gas engines and the distribution of metal it is very necessary to take into account the temperatures to which the parts will be subjected and explosions to be expected. With short cylinder, high-speed engines of comparatively small power, the cooling effect is so great that, with a fair amount of jacketing, no trouble need be looked for; but, with long cylinders, large diameters and the consequent high temperatures, it is easy to forecast that the cylinder body will become heated enough to fracture the surrounding outer jacket unless it is left free to expand.

HORSEPOWER.

There are several methods of arriving at the horsepower of a gas engine, but, in any case, it is much more difficult than with a steam engine. Naturally the old steam engine formula,

$$\frac{PLAN}{33{,}000} = \text{horsepower},$$

applies in the case of the gas engine, provided a person carefully remembers that N is equal to the number of explosion strokes only. However, it is almost impossible to obtain a correct indicator card from the gas engine, partly because of the violence of the explosions

TABLE 3.

Type.	Bore.	Stroke.	R. P. M.	Cubic Feet of Mixture per Minute.	Brake H. P.	Mean Pressure.	Cubic Feet per H. P.	Compression.	Fuel Used.	Amount per H. P. per Hour.
	Inches.	Inches.								Gallons.
Four-cycle, two-cylinder, vertical.....	6	10	282	45.7	16.8	90.4	2.72	67.5	Gasolene...	.16
			285	46.25	18.8	91.6	2.46	67.5	Alcohol....	.21
			286	46.40	18.4	86.1	2.52	87.	Alcohol....	.16
			285	46.25	18.3	83.2	2.52	87.	Gasolene...	.15
			282	47.5	16.8	80.9	2.72	110.	Alcohol....	.16
Four-cycle, single cylinder, vertical.....	6	8	340	22.23	5.91	.....	3.76	128.	Gasolene...	.31
			350	22.90	6.08	.....	3.76	128.	Gasolene...	.14
			358	22.9	6.08	.....	3.76	128.	Alcohol....	.18
			348	22.8	6.68	.....	3.41	128.	Alcohol....	.18
			344	22.5	6.6	93.5	3.41	128.	Alcohol....	.17
Two-cycle, single cylinder, horizontal...	7	8	335	59.7	1.52	.....	3.95	84.	Kerosene..	.35
			308	55.	6.42	.....	8.6	84.	Kerosene..	.15
			356	63.5	7.42	.....	8.6	84.	Alcohol....	.25
Two-cycle, two-cylinder, vertical.....	6	7	360	.....	14.4	50.5	2.86	32.		
Two-cycle, four-cylinder, vertical.....	6	7	440	.....	30.24	50.5	3.3	32.		
Two-cycle, two-cylinder, vertical.....	7¼	8¼	340	.....	21.75	85.4	3.08	24.3		
Two-cycle, three-cylinder, vertical.....	7¼	8¼	360	.....	36.0	85.4	3.05	24.3		
Two-cycle, four-cylinder, vertical.....	7¼	8¼	360	.....	44.2	85.4	3.21	24.3		
Two-cycle, two-cylinder, vertical.....	8¼	10½	320	.....	34.14	95.0	3.43	23.8		
Two-cycle, three-cylinder, vertical.....	8¼	10½	320	.....	56.	95.0	3.04	23.8		
Two-cycle, four-cylinder, vertical.....	8¼	10½	...	.....	.....	.....	.....	.....		
Two-cycle, two-cylinder, vertical.....	10¼	13	280	.....	60.0	.....	2.9	.....		
Two-cycle, three-cylinder, vertical.....	10¼	13	280	.....	90.0	.....	2.9	.....		
Two-cycle, single cylinder, vertical.....	5	5¾	450	.....	4.95	193.	2.96	13.2		
Two-cycle, two-cylinder, vertical.....	4¼	5½	400	.....	9.6	155.	2.48	17.6		
Two-cycle, four-cylinder, vertical.....	4¼	5½	...	.....	.....	.....	.....	.....		
Two-cycle, single cylinder, vertical.....	5½	6½	430	.....	7.09	92.	2.96	24.3		
Two-cycle, two-cylinder, vertical.....	5½	6½	425	.....	12.75	80.	2.85	26.5		
Two-cycle, four-cylinder, vertical.....	5½	6½	...	.....	.....	.....	.....	.....		
Two-cycle, single cylinder, vertical.....	6¼	7½	400	.....	9.6	90.	2.62	24.0		
Two-cycle, two-cylinder, vertical.....	6¼	7½	376	.....	18.32	90.	2.13	24.0		
Two-cycle, three-cylinder, vertical.....	6¼	7½	...	.....	.....	.....	.....	.....		
Two-cycle, four-cylinder, vertical.....	6¼	7½	...	.....	.....	.....	.....	.....		
Two-cycle, single cylinder, horizontal...	5½	9	291	18.0	6.13	102.	2.74	.....	Gasolene...	.21
	5½	9	290	17.9	5.03	86.1	2.94	.....	Gasolene...	.13
Two-cycle, single cylinder, horizontal...	5½	10	312	19.0	2.09	45.	9.1	.....	Gasolene...	.27
	5½	10	312	19.0	5.22	73.	3.64	.....	Gasolene...	.20
Two-cycle, four-cylinder, vertical.....	4¾	5⅞	660	77.0	26.3	.....	2.93	.....	Gasolene...	.16
	4¾	5⅞	780	91.0	29.2	.....	3.11	.....	Gasolene...	.17
	4¾	5⅞	680	79.4	27.7	.....	2.87	.....	Alcohol....	.20
	4¾	5⅞	670	78.2	27.3	.....	2.87	.....	Alcohol....	.21
Two-cycle, four-cylinder, vertical.....	4⅝	5 3/16	648	65.24	18.0	.....	3.62	.....	Gasolene...	.13
	4⅝	5 3/16	610	61.24	18.0	.....	3.4	.....	Alcohol....	.19
Two-cycle, single cylinder, vertical.....	4	4	500	8.75	2.25	.....	3.89	.....	Gasolene...	.29
	4	4	500	8.75	2.50	.....	3.5	.....	Alcohol....	.37

damaging the indicator, causing sinuous lines, and partly because the revolutions of the average commercial gasoline engine are faster than possible for the average indicator to take care of. It is not possible to forecast the mean pressure of a gas engine except by empirical formulæ, it not being possible to compile any theoretical formulæ, for the reason that a slight change in the water circulated or a difference of the conductivity of the oils in the different engines, or many other uncontrollable factors, would operate to change the tension of these very sensitive gases, whereas high temperature and small entropy render them liable to great variation, there being no practical formula that could possibly cover these variations. Never has there been an empirical formula whose constants could be relied upon except after long experience by a particular engineer with a particular class of engine.

One theoretical method which is more correct than many of the more complicated ones is to calculate the heat value of the fuel used and to multiply by the empirical constant representing the thermal efficiency from that particular class of engine as nearly as possible under the conditions under which it is expected to operate.

The writer has found the most satisfactory method of all to be that of cubic feet displacement per horsepower per minute. This is a fairly constant factor for given compression and given fuels. It seems to vary, so far as any practical amount is concerned, with compression alone. From a large number of practical tests with all kinds of engines, partly from theory and partly tabulated from the experiments of others, the results given in Table 3 were gained.

It will be noted from this table and from the results of the tests that commercial hydrocarbon engines average 3 cubic feet displacement per hour, and that this displacement varies approximately in an inverse ratio to the compression. This could be expressed in the form of a formula as follows:

$$\frac{Area \times stroke}{1728 \times C} = \text{horsepower},$$

C being the constant which varies above and below 3 cubic feet. On engines of high compression it will go as low as 2½ cubic feet and on engines of low compression it will go to 3½ and 4 cubic feet, or even more.

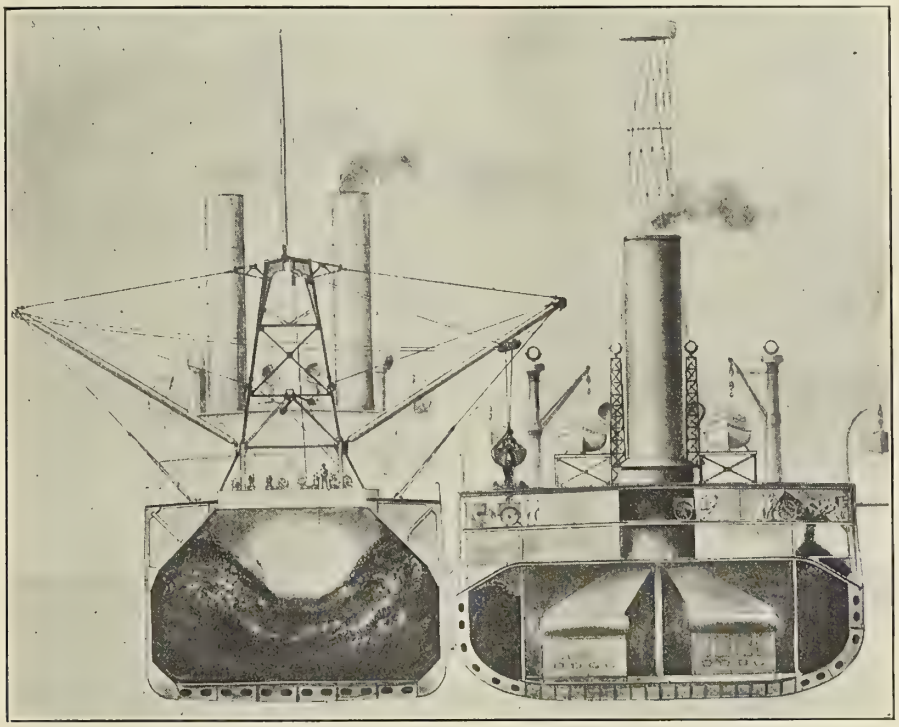
(*To be continued.*)

Coal Handling Gear on the U. S. Collier Neptune.

The Maryland Steel Company, which built the collier *Neptune,* adopted the Marine transfer manufactured by the Lidgerwood Manufacturing Company, 96 Liberty street, New York, because it presented an opportunity to employ an economical form of structure on board the ship, both in weight and in cost of fabrication. Square booms of steel are used instead of round ones, and a structural steel mast or tower is used in place of the usual round steel mast. Instead of tying these structural steel towers or masts there is employed a stiff member of inverted U-section. This member forms a trackway running lengthwise of the ship, and it also forms a support over each hatch for the overhead block of the transfer. A carriage running on this girder enables one to pick up coal from any of the hatches and deliver it to any other hatch or to the bunkers of the collier.

The Lidgerwood Company designed a new type of winch and control for operating the clam-shell bucket in its vertical and horizontal motions. With this type of control one winch hoists the bucket vertically and the other swings it horizontally in either direction. The two winches are independent of each

other, and can be worked separately or in union, each two winches being controlled by one operator. Only three levers are involved in the operation of the two winches—a hand and a foot lever for the bucket winch and a simple hand lever for the swinging winch. This control is extremely simple. Lifting a lever on the bucket winch causes the bucket to be raised, lowering the lever lowers the bucket, and putting the lever in mid-position stops the bucket. The swinging winch is operated in the same manner. Lifting the lever swings the bucket outboard, lowering the lever swings the bucket inboard. When this lever is placed in mid-position a steam brake is automatically set which will hold the swinging block or carriage so as to prevent movement of the bucket in either direction due to its load. Each winch has two drums. In the bucket winch the closing rope is attached to one drum and the holding rope on the other. In the swinging winch one drum operates the in-haul, the other the out-haul. The friction drums have patented metallic frictions with air-cooling passages of the Spencer Miller type. These frictions are not affected in any way by heat or weather, and their lifting power remains practically constant.



SECTION THROUGH THE COLLIER NEPTUNE AND A BATTLESHIP, SHOWING METHOD OF COALING.

Owing to the limited space aboard ship and the amount of power it requires to operate the clam-shell bucket smoothly and rapidly it becomes necessary to use high steam pressure. Because high steam pressure is employed, namely, 150 to 175 pounds per square inch, piston valves are used. With the employment of these valves excellent balance is obtained. The friction of the valve is small, and the troubles which are experienced with eccentric rods on ordinary high-pressure winches are believed to be eliminated, as is also excessive wear, which makes the piston valve desirable aboard a ship when only a few men are available for repairs or adjustment. The gears on all of the winches are of steel. The pinions are of bronze, and both have machine-cut teeth. This makes a practically noiseless running winch.

During the preliminary trials round trips were made as rapidly as two per minute from the bottom of the hatch, while 100 to 110 trips per hour will deliver the required guaranteed capacity.

Testing Corrosion Resistance in Tubes and Fittings.

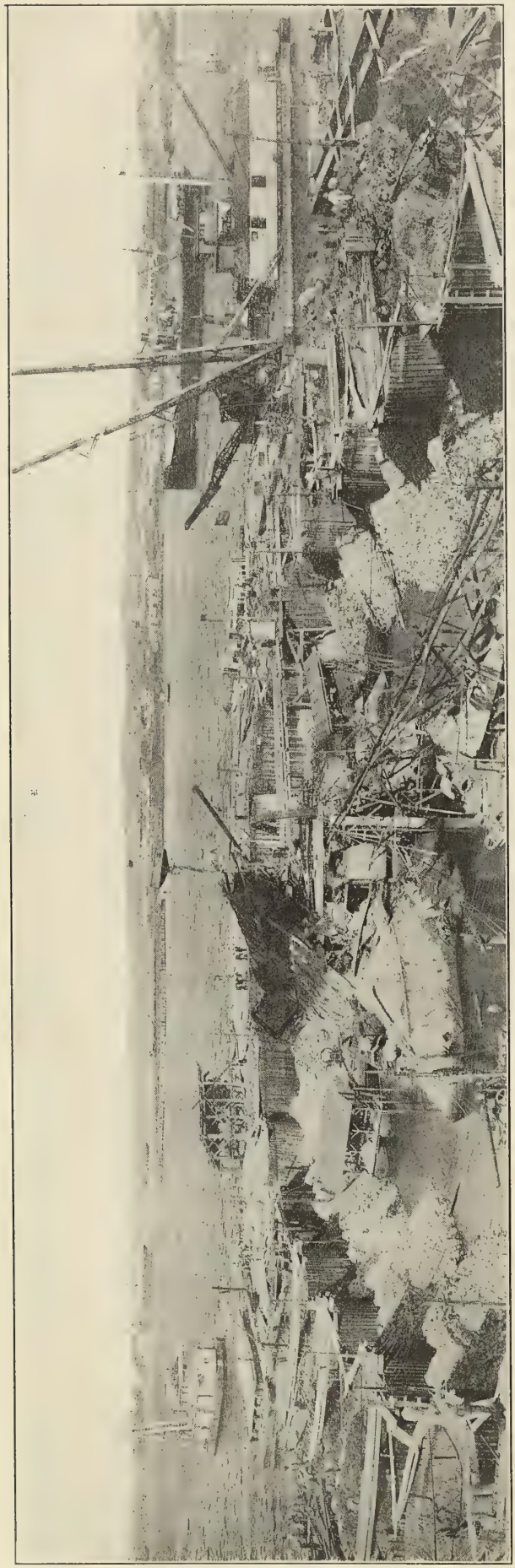
That the anti-corrosion value of brass and bronze tubes and fittings can be accurately determined by laboratory tests is shown in a paper read before the American Brass Founders' Association by William Vaughan, of Arthur D. Little, Inc., chemists and engineers, of Boston.

Corrosion may be defined as the effects produced upon a metal by the combined action of air and water, with or without the stimulus provided by the various impurities in the water or in the atmosphere. These corrosive effects are explained on the basis of: (1) Chemical action alone; (2) electro-chemical action, which may be caused by stray electrical currents from an outside source or by galvanic action, due either to included impurities or to the varying proportion of the different elements constituting the alloy. The main difference between two actions is in intensity. Effects that take months under the first can be accomplished in six or eight hours by the second. Accelerating the chemical action by an electric current gives, therefore, a comparatively simple method of determining the relative resistance to corrosion of the various metals.

On May 15, 1909, nine different kinds of tubes were installed in a surface condenser by the writer, twenty-five of each kind being inserted in vertical rows and designated alphabetically by punch marks at the top of the row. The remaining tubes in the condenser, some 3,400, were of "admiralty metal" (untinned), having the following composition:

	Percent.
Copper	70
Zinc	29
Tin	1

In all cases the failure took place by severe pitting and grooves running lengthwise of the tubes. In many cases small holes penetrated through the entire thickness of the tube. A large part of the failures was with tinned tubes, due probably to the electrolytic action set up between the metal and the tin wherever defects occurred in the tin coating. The pure



COFFERDAM SURROUNDING THE WRECK OF THE MAINE PARTIALLY DEWATERED.
(*Photograph by Underwood & Underwood, New York*).

copper tubes were particularly susceptible to corrosion, while the copper zinc tubes were much more resistant. The 60/40 and the 66/33 tubes showed practically no difference. The so-called "admiralty metal" appeared to resist corrosion better than the other brasses, and this, too, was indicated in the experiments, as the addition of a small amount of tin tended in most cases to diminish the rate of corrosion. A large amount of experimental work still remains to be done on alloys, but it is to be hoped that investigations will be carried out to such an extent that in the not distant future the employment of alloys which are rapidly destroyed by corrosion will be due to carelessness or willful intention and not to lack of proper information.

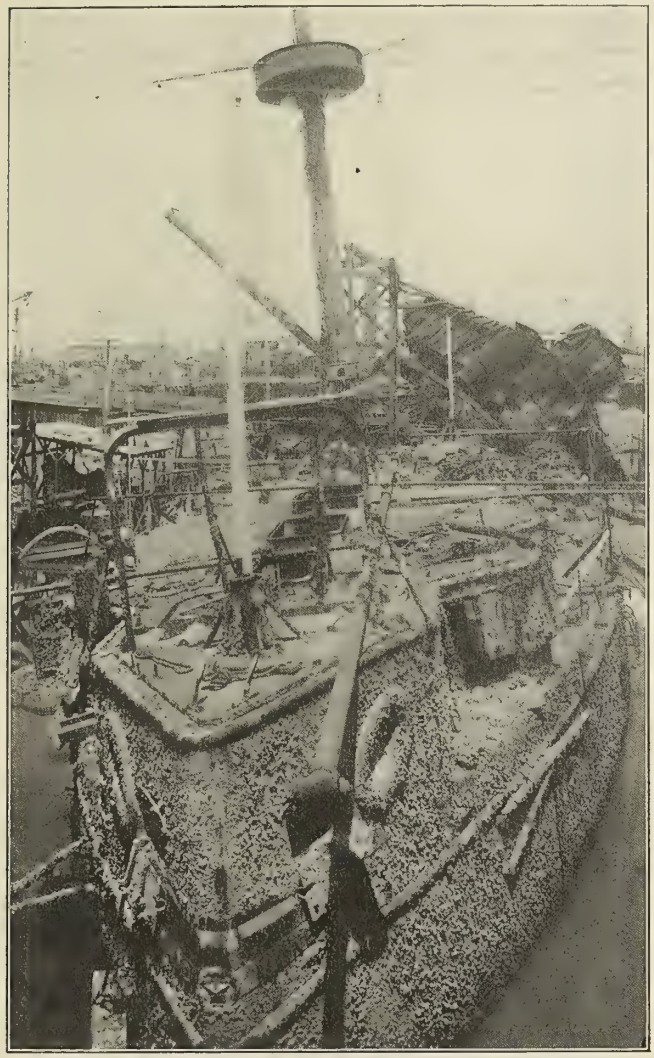
WORK ON THE WRECKED BATTLESHIP MAINE.

The battleship *Maine*, which has lain in Havana harbor for the past thirteen years, is now attracting a great deal of interest since the actual work of dewatering the cofferdam has begun. We show two very interesting views of the condition which has been revealed lately of the vessel. The work on the construction of the cofferdam was started last fall by the Board of Engineers, headed by Col. W. M. Black. The cofferdam consisted of twenty steel cylinders, each 50 feet in diameter, formed of the Lackawanna interlocking steel sheet piling. These steel cylinders were placed tangent to one another with arcs of piling connecting them on the outer face. To insure the stability of the cofferdam 20,000 tons of stone was deposited against the inner wall. The piling was driven by steam hammers of the Arnott type, built by the Union Iron Works, of Hoboken, N. J. The effect of the explosion, as shown by the illustrations, is far greater than was generally anticipated, and the barnacles on the bow of the *Maine* tell the story of what semi-tropical waters do to the submerged part of a ship.

General Bixby reported his opinion of the explosion as follows:

"The destruction of the *Maine* was caused by the explosion of three magazines. A portion of the deck over the magazines was blown upward and laid backwards. No explosion from the outside could have caused this result. What the primary cause of the explosion was will never be learned."

For removing the water within the cofferdam two large centrifugal pumps, electric driven, with double suctions, were used. They were especially built for the work by the Jeanesville Iron Works Company, Hazelton, Pa. The larger of the two pumps has 14 inches suction and 12 inches discharge; the smaller has 10 inches suction and 8 inches discharge, the discharge being, respectively, 4,000 and 1,800 gallons per minute against a head of 65 feet maximum and 5 feet minimum. The main castings of the pumps are of a special grade of cast iron; the impellers are of special bronze and the shaft is steel, bronze covered. The motors are 100 horsepower General Electric make, running 1,200 revolutions per minute, three-phase, 60-cycle, 220 volts, with a compensator for the large pump and a 50-horsepower motor for the smaller pump. Each pump is connected to its motor by a flexible coupling of pin and rubber buffer type. The pumps are mounted within the inclosure, and the current is obtained from a power-house on shore. The double suction construction gives a perfect rotative balance, thus eliminating all difficulties encountered from end thrust. The castings and bushings are split horizontally, thus permitting inspection to be made without breaking any pipe joints or deranging alinement of the plant. Two ring-oiling bearings with split renewable bushings are used, one on each side of the pumps, entirely separated from the casting by deep stuffing-boxes, making it impossible for grit or dirt to work into the bearings. The impellers are the inclosed type, chipped and filed to a finish, and fitted with re-



THE WRECKED BATTLESHIP MAINE.
(*Photograph by Underwood & Underwood, New York*).

newable bronze wearing rings, which when worn can be easily removed. The engineering work taken as a whole has been very successful. The method of doing the work is unique, but it reflects great credit upon those who have had it in charge.

Referring to International Marine Engineering, March, 1908, and May, 1908, our readers will find complete drawings and description of the second-class battleship *Maine*, together with an account of the explosion and the report of the naval court of inquiry regarding this disaster.

THE SOVEREIGN'S MACHINERY.

The remarkable showing of the yacht *Sovereign*,* built for Mr. M. C. D. Borden by the Gas Engine & Power Company and Chas. L. Seabury & Company, Con., Morris Heights, New York, has attracted much attention to this craft. The fact that this, the fastest yacht in the world, as far as we know, with an actual speed of 35 miles an hour, is fitted with reciprocating engines, calls attention to the following specifications:

Engines—Two Seabury four-cylinder, triple-expansion steam engines, 13½ inches diameter high-pressure, 20¾ inches diameter intermediate-pressure, and two low-pressure cylinders, each 26½ inches diameter, having a common stroke of 13½ inches. Each engine develops 2,500 horsepower at 500 revolutions per minute, with 350 pounds steam pressure.

Cylinders—Are of fine grain cast iron, cast with stanchion lugs and valve chest at the side.

Valve Chests—Are fitted with cast iron liners for piston valves. High-pressure and intermediate-pressure cylinders are each provided with one piston valve, and each low-pressure cylinder with two piston valves.

Cylinder Heads—Of cast steel ribbed and provided with bosses for relief valves.

Valve Gear—Consists of a side shaft running in bearings on the bedplate. This shaft is provided with cranks for each valve, and is driven from the crankshaft by means of three steel gears.

Reverse Gear—Of the regular Seabury type with bronze spiral sleeve operated by a hand lever.

Pistons—To be of forged steel dished, except the high-pressure, which is cast iron. Steel pistons to be provided with solid cast iron rings.

Piston Rods—Of special high-grade steel, tapered at the piston end and threaded to screw into the crosshead with lock nut.

Crosshead—Of solid forged nickel steel, babbitted for the wrist-pin bearing.

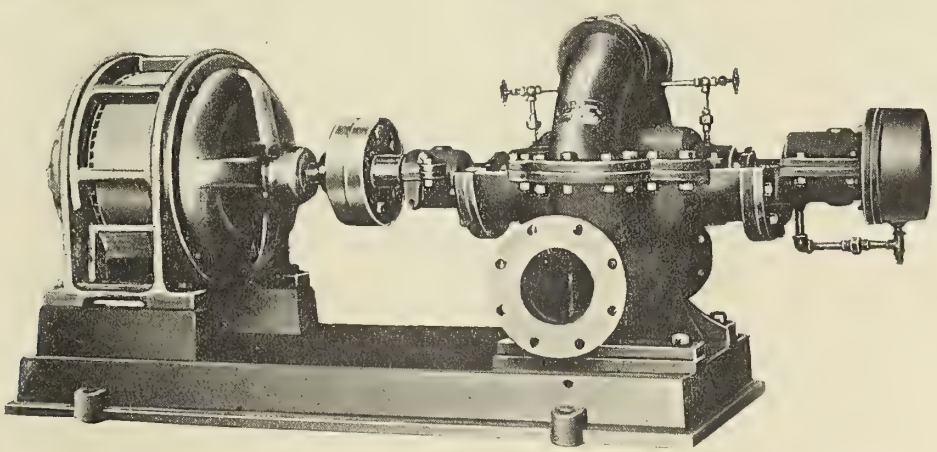
Crosshead Guide—Of cast iron, water-jacketed, with bronze backing gibs.

Framing—Consists of ten steel stanchions, well braced with diagonal fore and aft and athwartship braces. To the stanchions are bolted two steel guide rails to which are bolted the main guides.

Bedplate—Of cast steel sections bolted to steel angle-bars. Main bearings are babbitt lined and provided with cast steel cape secured with special steel studs.

Crankshaft—Of nickel-steel, finished all over, in two sections, with flange coupling for connecting line shaft.

* See description International Marine Engineering, June 1911, page 222.



ONE OF THE MOTOR-DRIVEN CENTRIFUGAL PUMPS USED IN DEWATERING THE BATTLESHIP MAINE.

Thrust Bearing—Of the horseshoe type, with roller bearings interposed between collars forged on shaft and cast steel horseshoes.

Connecting Rods—Of the regular marine type, of nickel-steel I-section with forked upper end and hollow steel wrist pin forced into eye. The lower end is a T-head, with manganese bronze babbitted boxes bolted on with special steel bolts.

Lubrication—By means of a McCord forced-feed lubricator of thirty feeds with leads to all important bearings.

Lagging—Cylinders to be well lagged with magnesia and Russia iron top. Heads to be filled with magnesia and covered with a brass plate.

Throttle Valve—Of the balanced lever type, to permit quick closing. To be constructed of cast steel.

Steel Steam Pipe—5¼-inch I. D. with separator and expansion joint in the line, both of steel.

Condensers—Of special type for securing economical working with small surface; ½-inch tubes except in way of incoming exhaust, these tubes being ⅝ inch. Condenser constructed of Muntz metal and copper, 9 feet long, 3 feet in diameter, one for each engine.

Boilers—Two Seabury watertube boilers, 15 feet long, 10 feet wide, 9 feet 6 inches high, containing 3,950 square feet heating surface each and 110 square feet grate surface. Boilers constructed in the main of ¾-inch O. D. tubing, except the three rows next to the fire, which are 1-inch O. D. Heater constructed of special drawn cast steel tubing. Boiler is double-ended, dry pipes take steam from two domes on each boiler. Designed to carry 350 pounds of steam, with an air pressure of 3 to 4 inches of water.

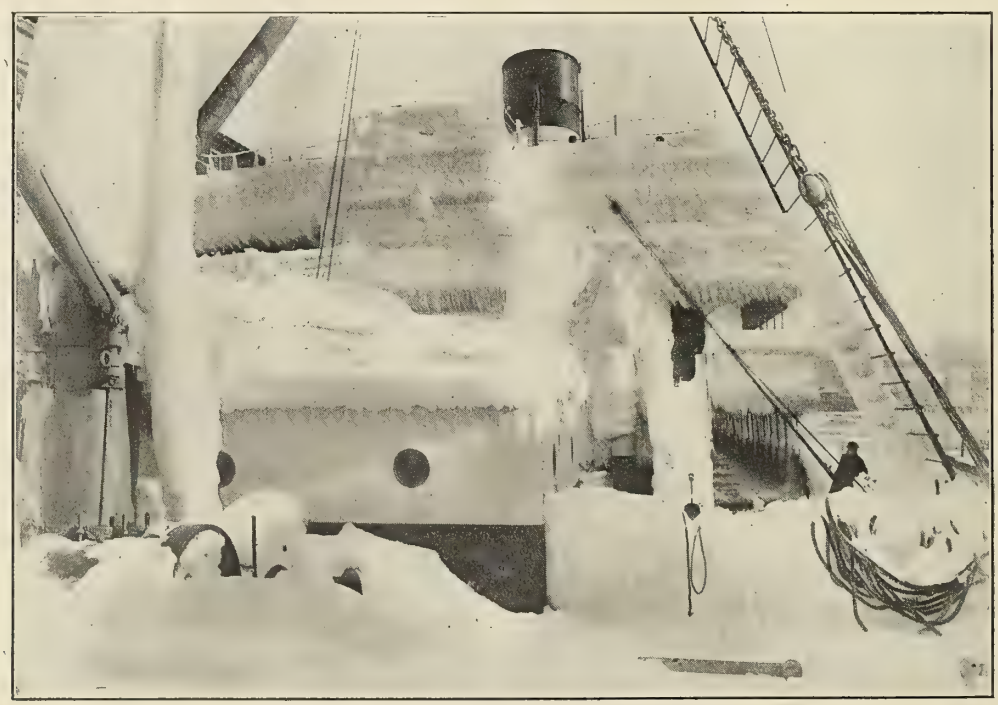
Pumps—Two Blake feed pumps for each boiler, 7½ inches by 5 inches by 8 inches, duplex, one in engine room and one in fire-room. Pump in engine room draws from the hot well, and is automatically governed by float valve. Pump in fire-room for emergency and make-up feed. Auxiliary air pump, Blake featherweight, 4 inches by 8 inches by 6 inches, simplex.

THE JOHN SHARPLESS AFTER WINTERING ON THE GALLOUP ISLAND SHOALS.

Cooling Pictures for Summer Use.

The steamer *John Sharpless* went aground on the Galloup Island shoal in Lake Ontario Dec. 9, 1910, and remained all winter. The accompanying illustration shows the vessel as she appeared in the first week in April, when she was floated by the wrecking firm of Baker & Reed, Port Huron, Mich. When the steamer went aground she had on board 70,000 bushels of corn, shipped from Chicago and destined for Ogdensburg, N. Y.

The *Canada* did not go ashore, but the accompanying picture shows that there was not much need for mechanical refrigeration on board when she entered Boston harbor one cold winter day some time ago.



THE STEAMSHIP CANADA IN WINTER DRESS.

THE SUBMARINE VESSEL.

BY K. DIETZE.

No fundamental changes have taken place in the modern submarine boat within recent years. The trend towards a type lying midway between the first serious productions of the older designers of submarines and the extreme submersible exemplified by the French *Narval* becomes more and more pronounced. A general review of the submarine and submersible question and a simple analysis of the general conditions of the problem may here be of interest.

At an early period in the history of the submarine boat, remote as its first beginnings are, the experience was gained that a state of suspension of a body under water is possible only in theory, and that practically every excess of weight, however small, suffices to make it sink and every inconsiderable excess of buoyancy to make it rise. This is due to the uniform specific density of the water within the range of depth which practically comes in question for the movements of a vessel below the surface. Very different from this is the case of an aerostat, which always remains at a certain definite height in the air, depending, apart from accidental influences, entirely upon its weight and upon the gas with which it is filled. For the specific density and with it the buoyancy of the air becomes less with every increase of height, it being considerably compressed in the lower strata by its own weight. If W be the weight and V the volume of a balloon, γ_w the specific gravity of its gas filling, and γ_l that of the air at the intended height of suspension, then, approximately,

$$V \times \gamma_l = W + V \times \gamma_w;$$

$$W = V\ (\gamma_l - \gamma_w), \text{ and } \gamma_l - \gamma_w = \frac{W}{V}.$$

If, as in Fig. 1, the specific density γ_l of the air be now set off as a function of the height H above mean sea level (Curve a) and the specific density γ_w of the gas filling, which, with

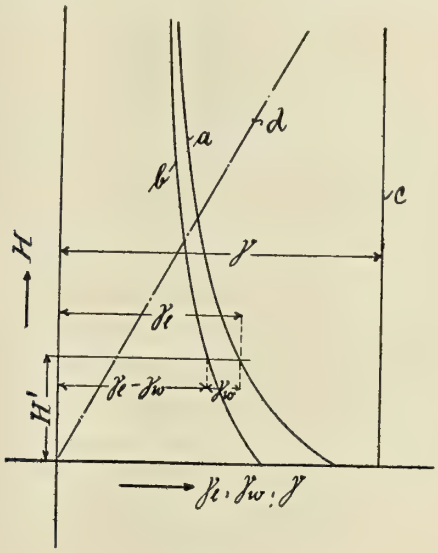


FIG. 1.

increase of height, is subjected to the same alterations as those of the air, be set back from Curve a (Curve b), it becomes possible (V being assumed constant) for every condition of loading to determine the approximate altitude H' by the calculation of the value of $(\gamma_l - \gamma_w)$, due to the weight and the finding of the corresponding point in the $(\gamma_l - \gamma_w)$ Curve b. Water, however, is practically incompressible; that is to say, its specific gravity γ does not alter with increase of the depth H (Curve c). Consequently, since γ is itself constant, the volume V cannot, in the submarine boat, be taken as constant for a different height of suspension with varying weight W as in the case of the balloon. Similarly it is not possible to find a value of γ corresponding with a particular condition of loading W from the equation $V \times \gamma = W$ (values of V and W corresponding with those for the balloon being assumed to exist). From this it will be clear that the existence of a state of suspension for a boat under water, while theoretically possible in itself, does not depend on the depth of immersion H.

The hydrostatic pressure $p = \gamma \times H$, which increases gradually with the depth, and which, similarly to the aerostatic pressure, is produced by the weight of the columns of water above the particles at the level H, takes the form of the

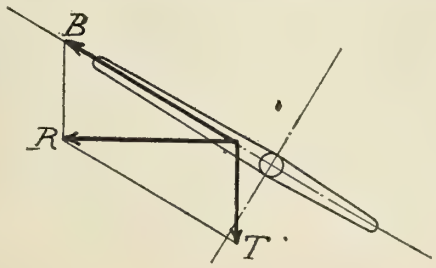


FIG. 2.

inclined straight line d without influencing the γ (curve c) in any way. This pressure renders impossible the use of the ordinary ship form for submarine vessels. The salient feature of a submarine boat must accordingly be a completely closed-in, boiler-like hull, and a circular form of section for this is found to be the one best able to resist the external pressure of the water. The first serviceable vessels of the older pure submarine type, therefore, in many respects, resembled the ordinary fish-torpedo, the invention and practical development of which did much to help them forward. The form of the longitudinal section of the torpedo has been adopted by many designers also, while others have altered the profile of the hull proper by the addition of more or less symmetrical excrescences. The midship sections of these older submarine boats—or, more correctly, their largest transverse sections—were arranged in many cases at the half-lengths of the vessels, and in others at points further forward. In general these arrangements depended on considerations of strength, resistance and stability.

Now since, as already stated, it was practically impossible to produce a state of suspension at any depth below the surface, it became necessary for the safety of boat and crew that diving be done with a small reserve of buoyancy, which may be called the permanent surplus, which then had to be forcibly overcome by special mechanical means. To effect this, appliances of all kinds have been tried. Of these, only that of horizontal diving rudders has survived; for the fitting of special screw propellers for diving and other devices of the kind has been given up. True, the slight tactical advantage of being able to dive vertically had therewith to be dispensed with, since the horizontal rudders worked only when the boat was moving ahead or astern. Nowadays two or three pairs of these rudders are commonly distributed over the length of the vessel; when one pair only is applied they are fitted, as in the case of a torpedo, at the after end, and if possible in the wake of the propeller, where they work very efficiently. The effect of the diving rudders may be seen in Figs. 2 and 3. If in the case most commonly met with in which two pairs of rudders are fitted, C represents the above-mentioned permanent surplus, and T_a and T_b be the vertical components of the rudder blade resistances R, we can set

$$2 \times \frac{T_a}{2} + 2 \times \frac{T_b}{2} = C.$$

Further, if a and b be the distances of the centers of the hydro-dynamic resistances (practically the centers of means distances) of the surfaces of the diving rudders from the vertical axis through the center of buoyancy F and weight G, we have

$$2 \times \frac{T_a}{2} \times a = 2 \times \frac{T_b}{2} \times b \text{ and } \frac{T_a}{T_b} = \frac{b}{a}.$$

The assumption is here made that the permanent surplus C lies in the vertical axis referred to. Otherwise a trimming moment $C \times x$ would also have to be overcome by the diving rudders during submergence. To this must be added another moment, which may be called the "moment of propulsion." If P be the component of the propeller thrust (see Fig. 3) in the

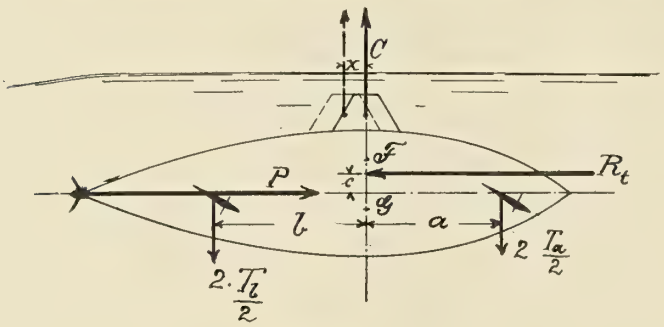


FIG. 3.

line of longitudinal motion, and R_t the total resistance of the boat, with all rudder pressures, erections and appendices in the submerged condition, R_t will not, as a rule, fall in the direction of P, but, in view of the complicated resistances of the extensive erections, may generally be assumed to act at a somewhat higher level. This at once establishes the couple $R_t \times c = P \times c$, the tendency of which usually is to raise the fore end of the boat, and which likewise has to be compensated by the action of the diving rudders. The last given equation thus takes the general form:

$$2 \times \frac{T_a}{2} \times a - 2 \times \frac{T_b}{2} \times b \pm C \times x \pm P \times c = 0.$$

The so-called permanent surplus buoyancy C, which is usually represented by the whole or part of the volume of the conning tower situated on the top of the hull, amounted, in the pure submarine boat of older design, to from ¼ to ½ a ton. It will at once be seen that this small surplus of buoyancy by which, during surface runs, the boat would alone project above water, would not suffice to provide the necessary seaworthiness and security. It became necessary, then, for the by far the most frequent surface runs to raise the boat higher out of the water; that is to say, to provide a certain freeboard, *i. e.*, a larger amount of reserve buoyancy, which for diving must be capable of being reduced to the ordinary surplus C by the taking in of water ballast. As regards buoyancy, then, three different conditions of the boat have to be distinguished (see Fig. 4):

1. For surface runs the normal surface condition, in which displacement $(D\gamma)$ = weight of vessel (W).

2. The half-submerged or awash condition, in which the full amount of the ballast water Q has been taken in, and the reserve buoyancy d is thereby destroyed. Here $(D + d)\gamma = W + Q$.

3. The submerged condition, in which the surplus buoyancy C is also overcome by the vertical components of the pressure of the diving rudders. Here

$$(D + d + C)\gamma = W + Q + \left(2 \frac{T_a}{2} + 2 \frac{T_b}{2}\right)$$

In contradistinction to the pure submarine boats of older design, which during surface runs already swam on their circular sectioned hulls and which had to find room for the necessary ballast water Q within the latter (see Fig. 4a), the whole of the water is in the extreme type of submersible banished from the inside of the inner hull and accommodated in external tanks. These latter, which represent such a marked new feature in the development of the submarine boat, were introduced by the former French Chief Constructor Laubeuf, who in the design of the *Narval* (Fig. 4b) arranged an entirely new outer skin round the hull proper to take the water ballast. It may readily be imagined that the space within the hull of the pure submarine boat of the older type was very much taken up by the requisite machinery, accommodation and crew, so that little room remained for the ballast water. The reserve buoyancy d, which is equal to the ballast in amount, could, in consequence, not be very large; it was only about 8 to 10 percent of the surface-run displacement. The earlier submarine boats could, in consequence, not be marked out for any very extensive use—they were only fair weather weapons of defense. The *Narval* design changed all this at one stroke. The reserve buoyancy could be increased to any desired extent, limits being put to it only by considerations of resistance and of the time taken to dive.

The *Narval* brought a further very considerable improvement with her in so far that, by means of the added outer skin, it at once became possible to make use of the old well-

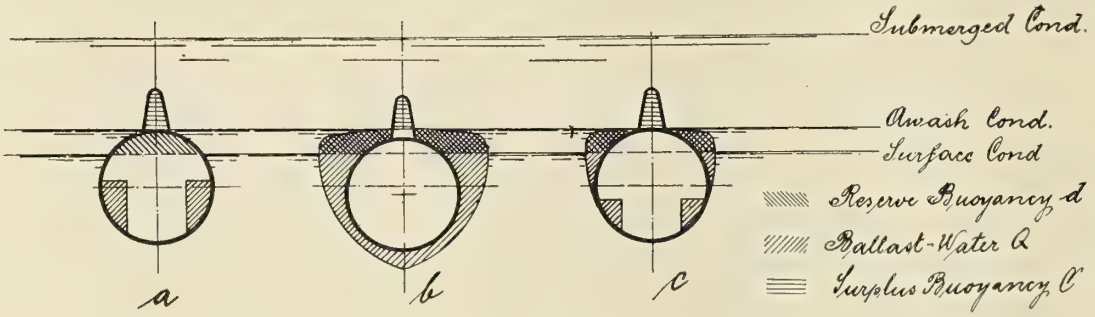


FIG. 4.

tried ship form for submarine vessels. In surface runs, indeed, the older submarines showed some very objectionable peculiarities. In the first place, they shipped a great deal of water, and. in the second, they showed a strong tendency to cut under the surface. It became necessary, therefore, on surface runs to trim them by the stern by means of ballast, thus destroying a part of the reserve buoyancy and increasing the resistance. In the submersibles the latter of these drawbacks is avoided and the former considerably reduced. Meanwhile the stability conditions are, at least at the small

angles, considerably improved, the freeboard increased, and the range of vision enlarged.

The *Narval* may be looked upon as an "extreme" design, in so far as practically the whole of the ballast water is removed from within the hull proper and placed in the external tanks. In the modern submersible (Fig. 4c), to which the designs of most of the navies now assimilate, only part of the ballast water, although the greater part, is arranged externally, while the rest is retained within the inner hull, so as to trim the vessel in the awash condition and to bring about an exact balance of the surplus buoyancy. The external tanks thus became somewhat smaller than in the *Narval,* a large part of the deadweight represented by the outer skin was saved, and in spite of this the remaining reserve buoyancy (30 to 50 percent of the surface-condition displacement) and the similarity to ordinary ship form were sufficiently preserved (Figs. 4c and 5). The permanent surplus buoyancy is increased to about 1.5 to 2 tons. In the fore body the modern submersibles

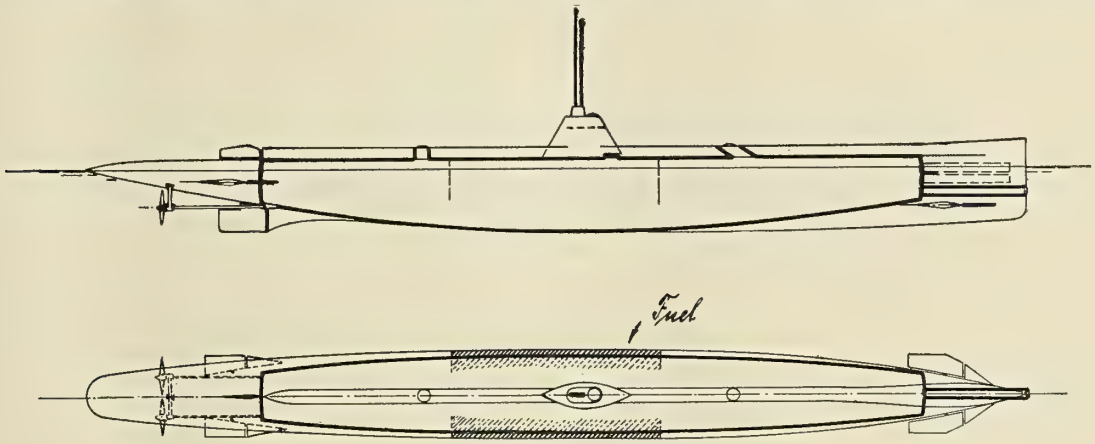


FIG. 5.

are almost exactly like torpedo boats, while the after body takes a somewhat different form, approaching to the well-known tetrahedron model. This form of after body offers many advantages: including greater initial stability, improved conditions of resistance, wider play for variation in the diameter of the propeller and more efficient working of the latter, because the water can very easily flow into it. Further, the facility of course-keeping in the vertical plane during subsurface runs is favorably influenced by the above-mentioned form of model, as will be seen further on. Extending over the whole boat is an erection, for the most part in tunnel form, exposed on all sides to the water, containing all the pipe leads. In many cases the erection is curved upwards in the fore body, whereby good working of the boat in a seaway is ensured. The inner hull accommodates itself as far as possible to the outward shape of the vessel; the pointed ends, forward and aft, have been cut off and replaced by strong, boiler-end shaped bulkheads. In the center of the pipe-lead tunnel, the top of which is utilized as a light platform deck, rises the conning tower, with its erections and appendages, which is itself strongly built to resist pressure and frequently armored. In it are the communication appliances, the periscopes, the steering gears, the central cocks for working the ballast tanks, depth manometers and the electrically-worked distance indicators of the compasses. The latter are often arranged outside the boat, on the one hand, because in the completely enclosed steel inner hull or in the conning tower the lines of force of the earth magnetic field are rendered almost immune, and on the other, because the effects of the free eddy currents within the boat, which are set up by the extensive electric installations, are thereby removed as far as possible. The possibility of vision is, unfortunately, still dependent on the makeshift assistance of the periscope, which can be withdrawn into the tower or into the interior of the boat. Windlasses or capstans may eventually be worked by electricity. When anchors are carried at all they are usually of the mushroom description, and capable of being drawn completely into their hawse-pipes, thereby these adapting themselves best to the shape of the boat. Life and working boats have been entirely banished from the submarine vessels; only on practice runs on which no dives are to be made are single small boats occasionally carried.

The motor question cannot yet be looked on as solved in a uniform manner. For surface runs, however, the heavy oil motor may be considered to have finally established itself, and its recent practical improvement has done a great deal towards the development of the submarine boat in general. Preference is shown in particular to an engine resembling the quick-running Diesel motor, which, even in France, where perhaps the greatest number of experiments with different surface motors have been made and return has repeatedly been made to the old, well-tried steam engine, appears to be finally accepted. Small height, short and compact build, very small weight and absolute reliability in working are demanded; the exhaust pipe, or opening, is placed for the most part as high as possible at about the after end of the pipe-lead tunnel, in order that the more powerful motors may during good weather be capable of being used in the awash condition also. For subsurface runs, of course, electric motors are used which have to be continuously fed from a storage battery. This latter is filled with peat moistened with acid, and is usually completely cased in, and provided with small tubes in order that the acid may not easily run over when the boat is inclined in either the transverse or the longitudinal direction, and that the gases developed in filling and during consumption of current may be able to escape. Connection is established between the individual motors by means of electro-magnetic couplings, one each of which is arranged between the oil motor and the electric motor, and between the latter and the propeller shaft. The electric motor is so arranged that it can be used as a dynamo, driven by the oil motor for the charging of the accumulators; it is for the most part completely cased in, but in way of large cooling openings wound round with wire, so that any explosive gases that may be ignited at the sliding contacts are confined to the interior of the motor. The starting of the oil motors may be effected by means of the electric engines or by compressed air, a sufficient quantity of which is always carried by the vessel or can be produced on board. In regard to the voltage, it is not found desirable to exceed 220, on the one hand, for the safety of the crew and the prevention

of short circuit, and on the other in order not to affect the compasses, which at the best are very unreliable.

In addition to its well-known advantages for ordinary vessels, the sub-division of the engine is further of special advantage for sub-marine boats, because the smaller units can be more conveniently accommodated in the inner hull; and, moreover, in a submarne boat in submerged condition the turning action of a single screw must be especially unpleasant. Now, although in the newer type of submarine boats faultlessly reversing heavy oil motors have been largely introduced, it has not been found desirable to dispense with the adjustable propeller blades. In engines of more than 200 to 250 effective horsepower this is, no doubt, an unsatisfactory makeshift, which, however, it is not thought advisable to dispense with, because the power of the oil motors cannot, for surface runs, be varied within sufficiently wide limits, and because the previous determination of the under-water power, *i. e.*, the suitable number of revolutions of the propeller designed for surface work is so difficult that the possibility must be provided of determining the maximum speed under water for each individual boat by experimental variation of the pitch of the propeller, without the power of the motors having to be reduced.

Cases are also met with of threefold and fourfold subdivision of the horsepower, by which various combinations become possible. With three screws, for instance, the central engine could with advantage take the form of a larger, more slowly running oil motor (with small dynamo for feed purposes), to be used alone for surface running, whereas the two outer ones were electric motors to be reserved for diving. These two outer motors could, however, in addition be connected with oil motors of small power, so that for surface running all three propellers could be set to work without it being necessary to bring the accumulators into play. On the other hand, the parts played by the propellers and their motors in connection with submerged and surface runs may, on occasion, be interchanged, the screw or screws not doing work being in each case allowed to run free. Similar combinations can, to a more extended degree, be resorted to with four propellers. All such variations depend on the calculation of the most favorable manner of overcoming the resistances. We here come to one of the most complicated and important theorems connected with the submarine boat.

For surface work the determination of the engine power necessary for a given speed, of course, presents no greater difficulties than in the case of an ordinary vessel; the Middendorf formula is said to give good results for modern submersibles, when the power otherwise necessary is increased by 30 percent to allow for the exceptional appendages of boats of this class, including in particular the torpedo exit excrescences and flaps. A good approximation is also given by the formula $I.\ H.\ P. = \frac{(\text{area of midship section}) \times V^3}{m^3}$; in surface trim the coefficient m ranges between 3.1 to 3.3 for modern type boats with $L : B$ from 10 : 11.5, this embracing all additional resistances.

For the determination of the resistances for the under-water runs, however, all the ordinary aids of this kind become useless, and only model experiments corrected by constants obtained from actual experience enable a prediction to be made for the under-water power of a boat of a particular type. This is also to be expected. The effect of the complicated tower formation, the diving rudders, and the pressures on these, and the rest of the appendages, such as the tunnel, the forecastle, etc., cannot be put into figures. Very roughly speaking, an average boat of 300 tons surface displacement for 8 to 9 knots under-water speed requires as much power as for a speed about 12 knots at the surface, the resistance of the horizontal rudders being in the former case included. As already observed, however, this uncertainty as to the speed that will be attained is got over by the adoption of adjustable propeller blades. With this the number of revolutions of the electric motors can be regulated at will. Meanwhile it must not be lost sight of that for the employment of the electric motor as dynamo a particular number of revolutions is necessary, which the oil motor must, while developing the necessary power, be such as to admit of. There can be no doubt that for under-water work the old submarine boats with their circular-sectioned hulls, so long as these were not deformed by the fitting of external oil tanks, as in the modern English designs, gave better propulsive results than the present-day submersibles. This is probably the reason why many of the naval administrations have so long adhered to the pure submarine boat with its evident disadvantages. But the modern submersibles are so dimensioned that the resistance keeps within reasonable bounds, even under water.

The accommodation of the ballast water in external tanks apparently offers advantages of such importance that a slight increase of resistance which accompanies it is willingly accepted. What has been said in the foregoing about the ballast tanks will in general, with slight alterations, apply to the oil tanks also. In cases in which oil motors were applied to the old submarine boats, these latter tanks had also to be arranged within the hull. In the submersible boats they have made their way with the ballast tanks to the outside, their most suitable position being at about half-length of the boat, so that in case of an unequal consumption of fuel the slight leverages with which they act admit of the smallest possible trimming moments (Fig. 5). Just as the removal of the ballast tanks to the outside brought with it an increase of the reserve buoyancy, so also the same maneuver with the oil tanks enabled these to have a much larger capacity; thus the radius of action of the modern submersible is, on the surface, far greater than that of the old submarine boats. Under water the case is different. Here a speed of about 9 knots and a radius of action of about 30 knots have to be made the most of. The space won by the removal of the ballast and oil tanks had to be used for the accommodation of the storage battery, which, as a result of the considerable increase of the displacement and the consequent increase of the under-water horsepower, became much more bulky. On the other hand, the surface speed was increased to 16 knots, and it will be seen that the modern submersible is, under surface conditions, becoming more and more a serviceable weapon of offense.

(*To be concluded.*)

Tonnage and Trade of the Port of London.

The increase by periods of ten years in the tonnage of British and foreign vessels entering the port of London from foreign countries and British possessions and coastwise (excluding vessels from the Medway) to discharge cargo, establishes the fact that, notwithstanding the gains made in other countries, the port of London still occupies a unique place in the world's shipping, as the following statement giving the tonnage entered for 1889, 1899 and 1909 shows:

Years.	From Foreign Countries and British Possessions. American Tons.	Coastwise. American Tons.	Total. American Tons.
1889.....	8,456,000	4,852,000	13,308,000
1899.....	10,571,000	6,664,000	17,235,000
1909.....	12,999,000	7,246,000	20,245,000

In the annual report of the port authorities the statement is made that the tonnage of ships which used the London docks during the year ended March 31, 1910, largely exceeded that of any previous year, and it is thought that the new schedule of dock rates, which went into effect on Jan. 1, 1911, will cause considerable additional shipping to enter the port.—*Daily Consular Reports.*

A Twin Hatch Steamer with Central Deck Ballast Tank.

In these days only those vessels which are carefully designed with a view to economy of working expenses and equipped with the most expeditious means for working cargo can hope to be kept fully employed. It is, therefore, imperative on the part of owners, as well as shipbuilders, to be keenly alive to any proposed improvements in the design and equipment of ships. One of the latest ship constructions is the invention of Mr. E. W. Ashby, a Tyneside naval architect, whose aim is to embody in a cargo vessel costing approximately the same as one of usual construction possessing equal dead-weight capacity several important advantages.

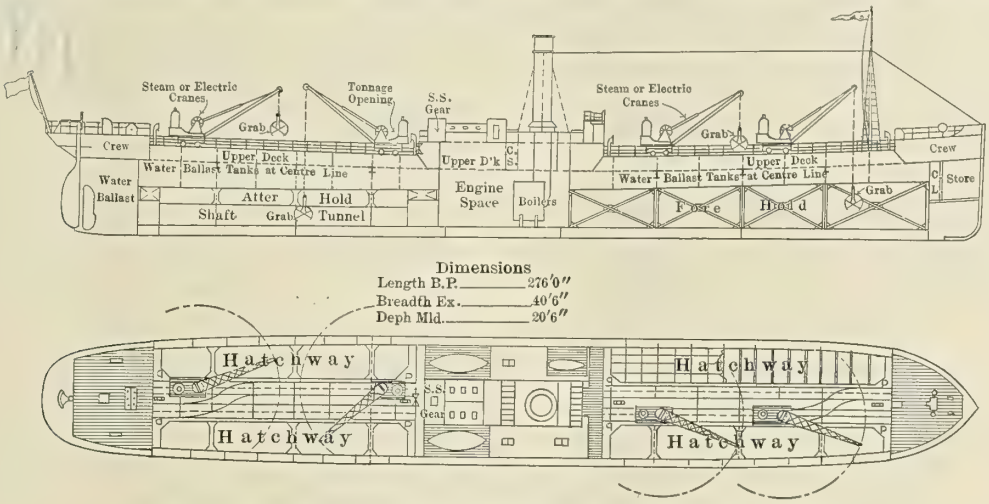


FIG. 1.—GENERAL ARRANGEMENT OF CENTRAL DECK BALLAST TANK STEAMER.

Referring to the illustrations, Fig. 1 represents the general appearance of the vessel. The distinguishing feature is the arrangement of continuous side hatchways on the deck, having deep coamings extending unbroken between the poop, bridge and forecastle. The outer coamings are fitted as close as possible to the sides of the vessel consistent with strength. Between the inner coamings is situated the working deck of the ship, raised considerably above the ordinary deck level, leaving 1 foot or less of these coamings standing above. This deck is continuous between the erections and can be gradually sloped as it approaches the bridge or poop in order to get the necessary tonnage openings in the end bulkheads of such erections. Between the hatches and below this deck is situated a water-ballast chamber, extending down below the molded depth level and having sloping sides meeting at the base. This tank, as will be seen in Fig. 2, is continuous forward and aft of the machinery space, the longitudinal strength being amply preserved by the bridge side and deck plating, extending considerably beyond the ends of the tank. It will also be observed that the bridge sides are in line and continuous with the outer coamings of the hatches. On the central raised deck, instead of the customary discharging gear composed of winches and derricks, etc., portable steam or electric cranes are used, moving along lines of rail attached to the deck and arranged to work self-filling and discharging grabs. This equipment, in conjunction with the long hatches on either side, will enable bulk cargo, such as coal, to be discharged with the minimum amount of labor. The cranes would possess all the usual motions and be constructed with warping drums, dispensing with the needs of winches for maneuvering the vessel in harbor.

The bollards, ventilators and other gear are also placed on this deck.

Referring to the midship section, Fig. 2, it will be seen that to preserve the transverse strength at the deck strong beams are arranged from the tank to the sides of the ship. These beams could be placed diagonally similar to the members of Warren girders in vessels designed to carry oil in bulk, preventing most effectually the increased tendency to work in such a ship, due to the nature of the cargo. Web plates are placed inside the tank to transmit the thrust, while the necessary support is secured by wide-spaced, strong pillars, braced in order to connect the tank rigidly to the remaining structure. A center-line bulkhead could be substituted in oil steamers, in which vessels the deck ballast chambers would be useful for trimming purposes. It will be noted that half beams are not necessary, the flanged beams being of sufficient size to support the small width of deck. At the top of the hatchways are placed the usual webs, spaced 4 to 5 feet apart, supporting the wood or steel covers. Fig. 1 shows the arrangement of a steamer of handy size carrying about 3,000 tons dead weight, Fig. 2 being the midship section, while the group of three sections, Fig. 3 and the annexed table of data, compare the capabilities and advantages of the different arrangements of hatches and water-ballast tanks. The particulars given have been carefully based on those of a vessel of normal construction, having the usual poop, bridge and forecastle, with two ordinary-sized hatches in each well.

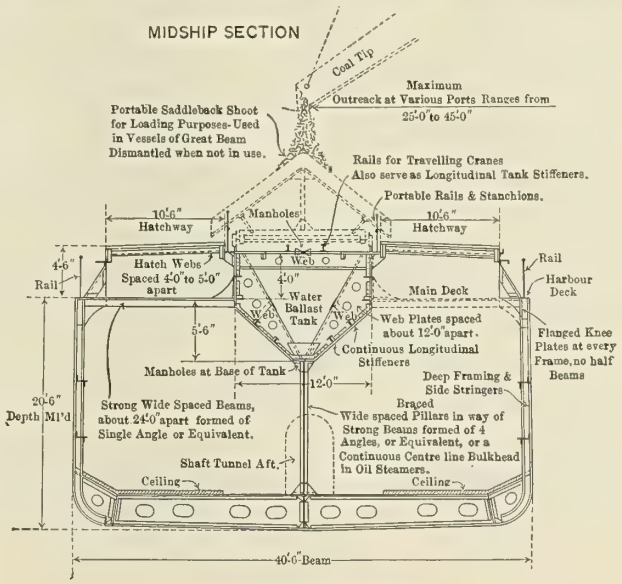

MIDSHIP SECTION
Coal Tip
Maximum Outreach at Various Ports Ranges from 25'0" to 45'0"
Portable Saddleback Shoot for Loading Purposes. Used in Vessels of Great Beam Dismantled when not in use.
Rails for Travelling Cranes Also serve as Longitudinal Tank Stiffeners.
Portable Rails & Stanchions.
10'6" Hatchway
Manholes
10'6" Hatchway
4'6"
Rail
Hatch Webs Spaced 4'0" to 5'0" apart
Web
4'0"
Water Ballast Tank
Web
Web
Main Deck
Rail
Harbour Deck
5'6"
Web Plates spaced about 12'0" apart.
Flanged Knee Plates at every Frame, no half Beams
Continuous Longitudinal Stiffeners
Manholes at Base of Tank
12'0"
Deep Framing & Side Stringers
20'6" Depth Mld
Strong Wide Spaced Beams, about 24'0" apart formed of Single Angle or Equivalent.
Braced Wide spaced Pillars in way of Strong Beams formed of 4 Angles, or Equivalent, or a Continuous Centre line Bulkhead in Oil Steamers.
Shaft Tunnel Aft.
Ceiling
Ceiling
40'6" Beam

FIG. 2.—MIDSHIP SECTION.

The advantages claimed for this construction are numerous. Considering first the structural arrangement, the vessel has

greatly increased longitudinal strength, due to a much larger percentage of the steel work at the deck being utilized in resisting longitudinal stresses than is ordinarily the case of steamers constructed with the usual hatches and winch platforms; moreover, the stiffening of the central tank longitudinally instead of transversely, as with side tanks, adds to the longitudinal strength. This would allow much greater length to depth than usual, also allowing the dead weight to be carried on a reduced draft of water relatively to that of a vessel of normal construction. The water ballast capacity is about equal to that secured by the same vessel if constructed with top-side wing tanks, about half of the total ballast being carried at the deck, and the compartment being arranged along the center line of the vessel would prove free from straining and leakage. The actual capacity of the tank, of course, is to some extent governed by the width of hatches required. The disposition of the ballast and its influence on the metacentric height and draft in ballast, as shown by the data given, should produce a steadier and more comfortable ship when in such trim, without undue strains. Perhaps the most important advantage gained by this method of construction, viewed from the shipowners' standpoint, is the increased immersion allowed this type of vessel by constructing the deck ballast tank partly above the molded depth level, which, in conjunction with the continuous side hatchways, forms a substantial erection, connecting up the ordinary erections and giving extra strength and reserved buoyancy, so that with little increase in the weight of steel structure over that of the normal vessel a valuable reduction of the freeboard, and therefore a considerable increase in the dead-weight capacity of this ship, is gained, by the arrangement of the hatches and the formation of two trunks or feeders to the hold proper,

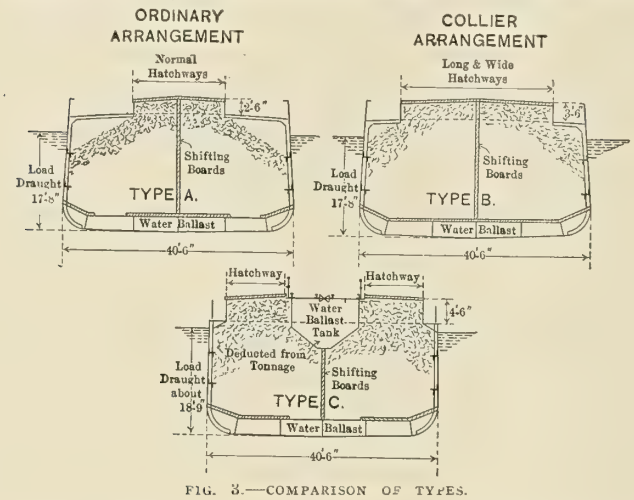


FIG. 3.—COMPARISON OF TYPES.

COMPARISON OF TYPES.

Item.	Type A.	Type B.	Type C.
1. Total estimated weight of steel....Percent	100	102	103.5
2. Weight of ship completed.....Tons	1,310	1,350	1,350
2. Dead-weight capacity.....Tons	3,110	3,070	3,410
4. Net tonnage .....Tons	1,030	1,130	1,020
5. Total cubic capacity, including bunkers (and top-side tank).....Cubic feet	154,850	162,550	176,050
6. Cubic capacity, excluding bunkers..Cubic ft.	148,400	156,100	169,600
7. Capacity available for untrimmed coal cargo .....Cubic feet	112,900	138,800	141,000
8. Total water-ballast capacity.....Tons	765	765	1,295
9. Mean draft with ballast and permanent bunkers	9′ 10″	10′ 2″	12′ 0″
10. Metacentric height, with ballast and bunkers	8′ 0″	7′ 9″	4′ 3″
11. Deadweight ÷ net tonnage.....Tons	3.02	2.72	3.34
12. Total cubic capacity (5) ÷ net tonnage, Cubic feet	150	144	173
13. Capacity for untrimmed coal cargo (7) ÷ net tonnage .....Cubic feet	110	123	138
14. Total cubic capacity (5) ÷ deadweight, Cubic feet	50	53	51.5
15. Capacity for untrimmed coal cargo (7) ÷ deadweight .....Cubic feet	36	45	41.5
16. Deadweight ÷ weight of steel (1), Percentage	100	96.5	106
17. Total cubic capacity (5) ÷ weight of steel (1) .....Percentage	100	103	110

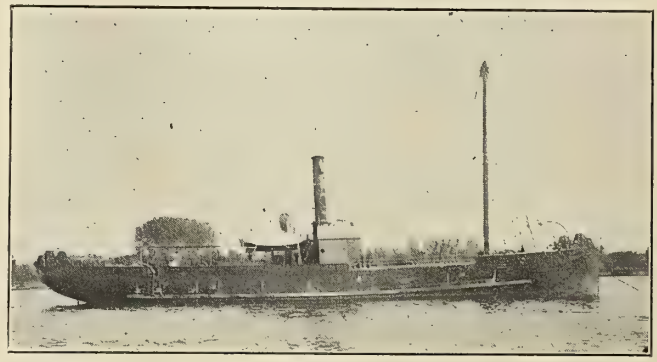
enabling such a ship to carry full cargoes of grain in bulk and dispensing with the necessary bagging otherwise required by law, while the expense of fitting shifting boards at the center line is reduced to about half, as the quantity required is necessarily small, the deck tank taking the place of the upper portion of these boards. By tapering the tank practically to a point at its lower extremity, and having the hatch coamings closer than usual to the sides, a self-trimmer is produced. Compared with other types, a greater percentage of the hold and hatch space can be filled without any trimming.

The Wrecking Submarine Boat Vulcan.

The *Vulcan* was designed by the French government to assist in case of accident the submarine vessels of their navy, and her building was kept very secret, but we were able to obtain a photograph, which we give in this issue. She is designated, however, in the French navy not as a wrecking boat for submarines but a steam lighter. Her dimensions are as follows:

Total length	141 feet.
Extreme breadth	22 feet 6 inches.
Draft	11 feet 10 inches.
Indicated horsepower	450
Speed	11 knots.

She is built entirely of steel and very stoutly. She is double bottom fore and aft, this double bottom having a height of 4 feet most of her length. The compartments adjoining the engine and boilers are watertight. She is divided into eight longitudinal compartments. She is fitted with a single



STEAM LIGHTER USED AS A WRECKING BOAT FOR SUBMARINES.

marine boiler, which furnishes steam to the main engines and the auxiliaries.

Her main engines are triple-expansion with three cylinders, making 105 revolutions, giving a speed of 11 knots.

On her trial trips she ran over 12 knots. She is fitted, it will be noticed, with davits in the bow, the use of which is apparent.

Just how this vessel will act when needed is a question which is yet to be settled.

Recent Trials of U. S. Battleship Utah.

With the recent trial of the *Utah* the United States Navy Department is in possession of data of three Dreadnoughts which, while not identical in size or power, are sufficiently near to enable valuable and instructive comparisons to be made.

The *Delaware* and *North Dakota* have identical hulls and are nominally of the same power. The *Utah* is of the same length as the other two, but has 3 feet more beam and about

18 inches more draft, so her displacement is nearly 2,000 tons greater. She is fitted with Parsons turbines.

In the case of these three ships the boilers are Babcock & Wilcox, of standard construction, as supplied to the United States navy for large vessels. The boilers of the *North Dakota* and *Delaware* have 1,439 square feet of grate surface and 61,950 square feet of heating surface. The *Utah* has 1,428 square feet of grate surface, with 64,308 square feet of heating surface.

The following are the results of the *Utah's* official trials at three rates of speed, but it will be noted that the horsepower is only on the main shafts of the turbine and does not include the auxiliaries:

Duration of trial (hours).....	4	24	24
Number of Parsons turbines in use	4	5	6
Speed developed (knots).....	21.04	19.2	12.02
Shaft horsepower	27,038	17,150	3,938
Revolutions per minute.....	323.4	281.7	172.5

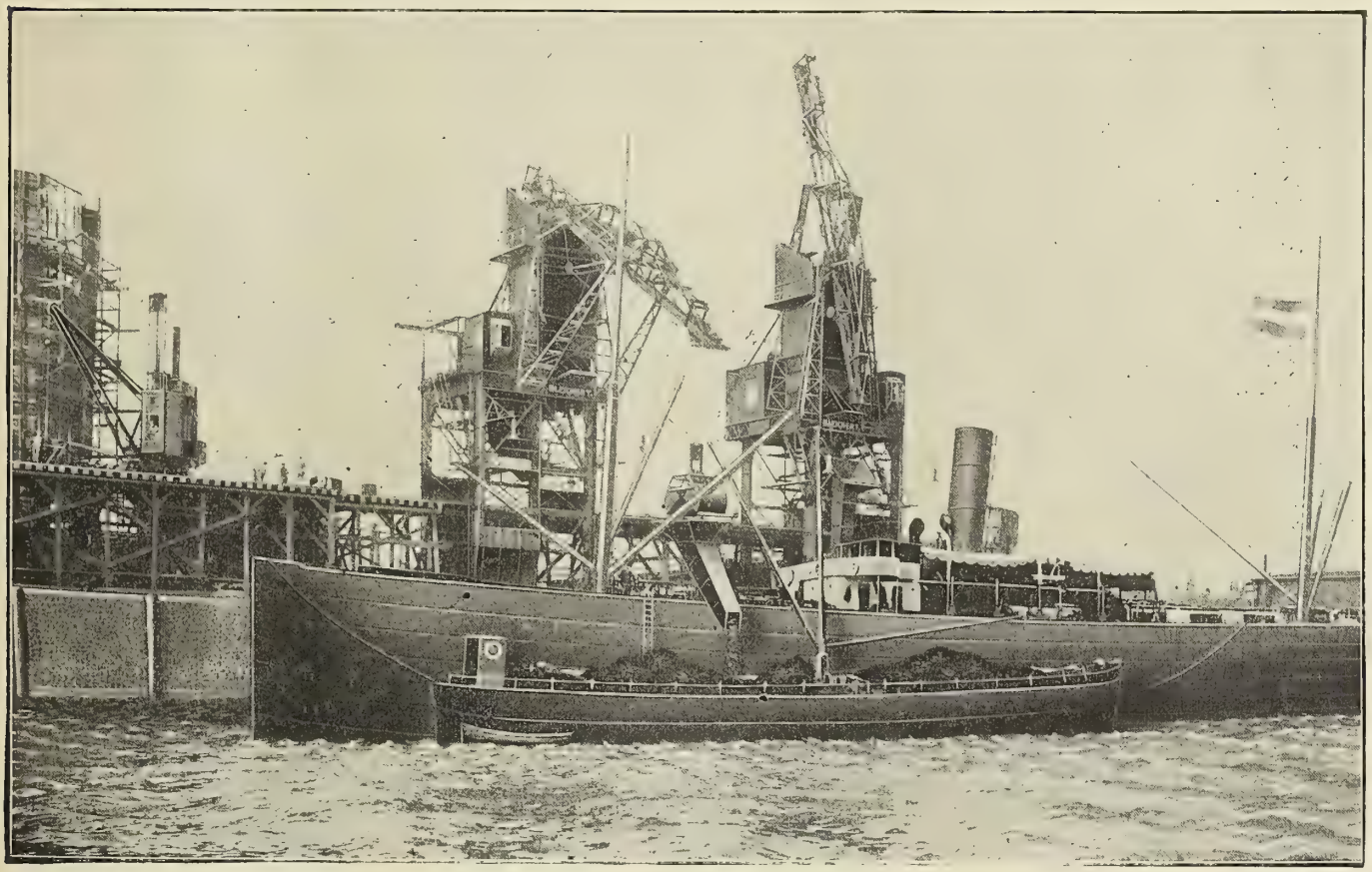
The *Delaware* on trial made a maximum speed of 21.56 knots, with 29,043 horsepower for all purposes. The *North Dakota* made 21.01 knots, with 32,307 horsepower for all purposes.

Economical Results Obtained with a Loading Plant.

The enormous savings which can be made with modern loading appliances are shown by figures covering the performance of a new type of crane erected for the first time at the Grasbrook Gas Works, Hamburg, the characteristics of which can be seen in the illustration. The figures will be found of special interest, as a comparison is made with former mechanical appliances instead of with manual labor.

In bringing the jib of this crane into working position it does not drop in the usual way, as its special support on two hinged rods enables it to slide under the tackle, and thus make room for the action of the grab. Thus on sailing vessels the otherwise frequent and extensive repairs to the tackle are avoided, and on steamers there is no danger of collision with the wires for wireless telegraphy. The whole work, in particular the changing from one ship's hold to the other, is much simplified, so that the working pauses are reduced to a minimum. The result of this is an extremely good average capacity, which was assumed at 75 tons per hour for each crane, although, as a matter of fact, an hourly capacity of 100 tons has been attained, and even considerably more when the conditions have been favorable and the hatchways of the steamers of sufficient width.

The statement of the savings made is even more remarkable. Formerly the coal vessels were unloaded by means of a hydraulic and a steam crane, by lowering small trucks of 1-ton capacity into the ship and loading them by hand. During this operation two men were required to control the cranes, with an additional laborer on the steam crane, two men to direct the trucks, and twenty men to shovel in the coal, or a total of twenty-five hands. The discharge of the coal, including transporting to the coal sheds over an average distance of about



A NEW TYPE OF CRANE FOR WHICH GOOD RESULTS ARE CLAIMED IN LOADING STEAMSHIPS.

The Argentine Republic Minister of Public Works has signed a contract for the construction of a drydock at Puerto Belgrano capable of holding the large battleships now being constructed in the United States for government of Argentina. The cost will reach $6,369,000, and the work is to be completed in three and one-half years, meeting the rapidly increasing demands for docking facilities for naval and mercantile vessels.

390 feet, cost about 6¼d. per ton, and about ½d. extra for steam and lubricating material, so that the total cost of discharging came to about 6¾d. per ton.

Compared with these figures, the attendance on the two unloaders already erected (two further cranes are at the present time in course of construction) is very insignificant, as only two crane operators and four men in the ship—or together six men—are required, representing a saving of no less than nineteen hands. The cost of discharge and transportation to the sheds now amounts to about 3d. per ton, with an extra 1¼d. for current, which will, however, later fall to about ¾d., so that about 3¾d. will be paid instead of the 6¾d. under the former arrangement. This represents a saving of about 50 percent on working expenses, or a profit per annum of about $6,570 (£1,350), assuming the present traffic of 100,000 tons.

In addition to this amount the allowance for reduced time required for unloading, which is calculated at fixed standards, must be taken into account. The time allowed varies according to the size of the steamer, but averages thirty-six hours per 1,000 tons, and an allowance of 6s. is made to the gas works for every hour saved. Now, assuming an average capacity of 100 tons per hour for each unloader, 1,000 tons can be discharged in five hours with the two cranes already erected, or an average of thirty-one hours for 1,000 tons, or more than 2¼d. per ton; even in practical work on a large bulk of coal there was found to be an actual saving of 1¾d. per ton. To keep on the safe side we will therefore take the latter figure as a basis, and even this shows a saving for reduced time in discharging of about $3,407 (£700) per annum, which is increased to about $9,733 (£2,000) by the reduction in the sum paid for wages.

When the gas works are fully built to consume 360,000 tons per annum, the actual saving will be no less than $3,504 (£7,200). As soon as the two new cranes are completed the plant is also intended to transfer coal from seagoing vessels into barges, as shown in the illustration, for the use of the gas works Barmbeck and Billiwärder. For this service an allowance will be made to the Grasbrook works of about 8¾d., this rate including about 2¾d. for the cost of current. The profit here will therefore be about 6d., or, including the saving for reduced time in unloading, 7¾d., which would represent a further profit of about $28,226 (£5,800) on a yearly consumption of 180,000 tons. The total profit accruing per annum is therefore no less than $63,265 (£13,000), which would cover the entire cost of the plant in about one year's time.

This plant has been constructed by Messrs. Adolf Bleichert & Company, London and Leipzig.

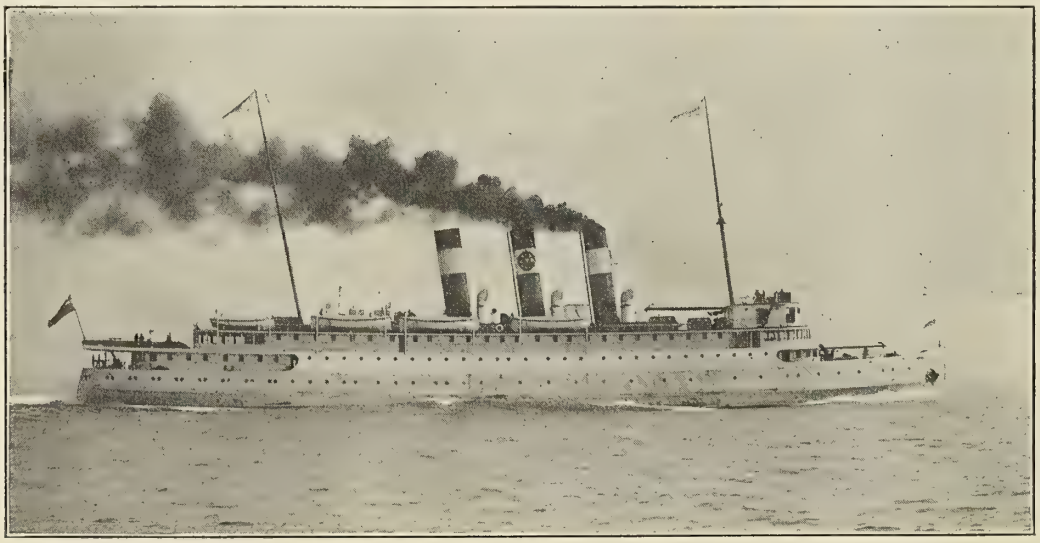
TWIN SCREW PASSENGER STEAMER PRINCE RUPERT.

The *Prince Rupert* was built by Swan, Hunter & Wigham Richardson, Ltd., at Wallsend-on-Tyne, to the order of the Grand Trunk Pacific Railway Company of Canada. R. L. Newman superintended the building of this vessel and another similar one. These steamers inaugurate a new service between Prince Rupert, which is the western terminus of the Grand Trunk Pacific Railway, and Vancouver, and thence to Victoria at the southern end of Vancouver Island, and onwards to Seattle or Tacoma.

The steamer has a smart appearance with its straight stem and cruiser stern. There are two pole masts and three funnels, the center one bearing the flag service of the company, viz.: a maple leaf in a circle traversed by a band bearing the initials G. T. P. The rounded cruiser stern has been adopted in order to obtain the best lines to give high speed. On service the ship will run at 17 to 18 knots an hour, though about 19 knots may be attained. The principal dimensions of the *Prince Rupert* are 320 feet over-all in length, 42 feet 2 inches in breadth, with a depth of 18 feet to the main deck. The ship is built to the highest class under the British Corporation survey, and also complies with the Board of Trade regulations for passenger steamers. The gross tonnage is 2,850. The engines and boilers, with Howden's forced draft, were constructed by the Wallsend Slipway & Engineering Company, Ltd. The former consist of two sets of triple-expansion engines, balanced on the Yarrow, Schlick and Tweedy system.

On the shelter and shade decks are staterooms of two berths each for about 220 first class passengers. There are also a few sets of staterooms *en suite* on the shelter deck amidships. Second class passengers are carried on the main deck forward. When occasion arises about 1,500 excursionists can be taken on board. A pleasant feature of the first class accommodations are two spacious corridors running fore and aft, one on each side of the engine casing, and to enhance the general appearance light is given from several domes in a long roof, which also has a clerestory. This design, besides affording plenty of light and ventilation, gives a lofty appearance to the interior. The dining saloon on the main deck is at the extreme after end of the vessel. The rounded shape of the cruiser stern makes a handsome room, which is furnished and paneled in oak. Instead of having large tables there are several small ones placed in bays. Immediately forward of the dining saloon are the stewards' pantries and the kitchens.

At the after end of the shade deck is a handsome smoke-



STEAMSHIP PRINCE RUPERT FOR THE GRAND TRUNK PACIFIC RAILWAY COMPANY.

room for first class passengers, paneled in fumed oak. The second class smoke-room is at the forward end of the shelter deck. There are special accommodations for ladies in the shape of a music room, daintily furnished in light colors, the painting being white enamel. The main staircase is a notable feature, the paneling of the walls being in white enamel and the balustrades of wrought iron elegantly designed. The promenade on the shade and boat decks is spacious. On the shade forward of the funnels is the observation room, paneled in maple and sycamore. This room is specially lofty and well lighted by very large square windows, allowing passengers to have an uninterrupted view of the scenery en route. The cabins in all the deckhouses have wide rectangular sliding windows, provided with jalousie screens. The *Prince Rupert* has a wireless telegraphy installation, refrigerating machinery for ship's stores and dairy produce, electric light and steam heating throughout. The rudder is of the balanced type, wholly below the waterline, and is actuated by a telemotor steering gear.

STEAMSHIP METAPAN DESIGNED FOR THE WEST INDIAN FRUIT TRADE.

FRUIT STEAMSHIP METAPAN.

The *Metapan* is the twelfth vessel built by Messrs. Workman, Clark & Company, Ltd., Belfast, for the Tropical Fruit Steamship Company, Ltd., Glasgow (Messrs. Clark & Service, managers), and, like her sister vessels the *Santa Marta* and *Almirante,* has been specially designed and constructed for the West Indian fruit trade. She is 394 feet in length and has a gross tonnage of over 5,000 tons. A special feature of the vessel is the accommodation for over 100 first class passengers. The staterooms are roomy, arranged for two and three persons, and include a number of special rooms with iron bedsteads and artistic furniture and having lavatories adjoining. The public rooms include a large, well-lighted dining saloon, with tables arranged on the restaurant system; a spacious entrance hall, arranged so as to mitigate as far as possible the congestion which frequently occurs at time of embarkation; a luxurious music room, opening off the entrance hall, and a comfortable smoke-room. All these rooms have been arranged and furnished with a view to securing the utmost comfort and pleasure of the passengers, the furnishings and decorations being of the most luxurious and artistic character, while the lighting and ventilation of all the rooms, private and public alike, have received most careful consideration.

The cargo space is divided into eight compartments, which have been thoroughly insulated and arranged for the carriage of fruit cargoes in bulk, and the preservation of these cargoes is ensured by the installation of an efficient plant of refrigerating machinery for the provision of cooled fresh air, which is delivered through ducts to each of the compartments by electrically-driven fans, thus securing the maintenance of an equitable temperature at all times. Access to the holds is by four large hatchways, equipped with steam winches, derricks and other appliances necessary for expeditiously dealing with a general cargo and fruit in bulk, while a special steel derrick is provided for lifting exceptionally heavy weights. The vessel is propelled by a set of improved triple-expansion engines, supplied with steam from five single-ended steel multi-tubular boilers working under forced draft. The *Metapan* has been built under special survey for the highest class in the British Corporation Registry of Shipping, and fulfills the requirements of the British Board of Trade and the United States Steamboat Inspection Service.

This vessel is a striking example of the embodiment in one design of the features developed in recent years to provide for the comfort and safety of passengers and the economical distribution and handling of freight. The trials and the initial voyage of the ship proved the efficiency and reliable action of her propelling machinery.

ENTRANCE HALL ON THE METAPAN.

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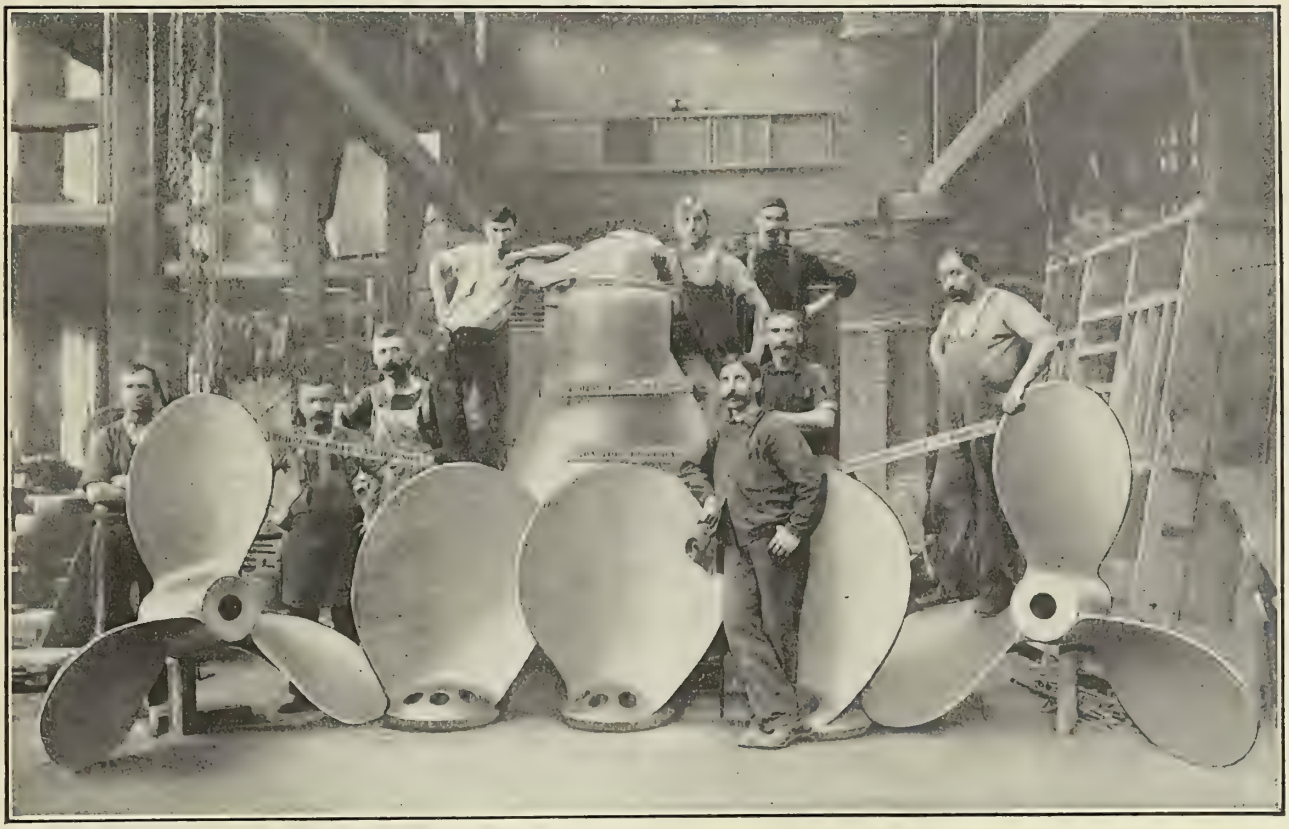
—PROPELLERS—

WHAT IS THE FIRST REQUISITE FOR A PROPELLER?
A HIGH GRADE COMPOSITION METAL.
WHAT ARE THE ESSENTIAL CHARACTERISTICS OF THIS METAL?
GREAT STRENGTH, TOUGHNESS AND NON-CORROSIVENESS.
HOW CAN THESE ESSENTIALS BE GUARANTEED?
BY USING VICTOR VANADIUM BRONZE.



Like few other high grade compositions, Victor Vanadium Bronze is non-corrosive in salt water. It is very strong and tough, as well as ductile, showing a tensile strength of 70,000 lbs., and an elastic limit of 40,000 lbs., and it has a very close molecular structure.

Probably one of the most distinctive points is the light weight of Victor Vanadium Bronze compared with other bronze compositions possessing high tensile strength. The specific gravity of Government bronzes runs from 8.75 to 8.85, while that of Victor Vanadium Bronze is only 7.84, a decrease of over 10%.

Specify Victor Vanadium Bronze in your propellers.

VANADIUM METALS COMPANY

GENERAL OFFICES - - - - PITTSBURGH, PA.

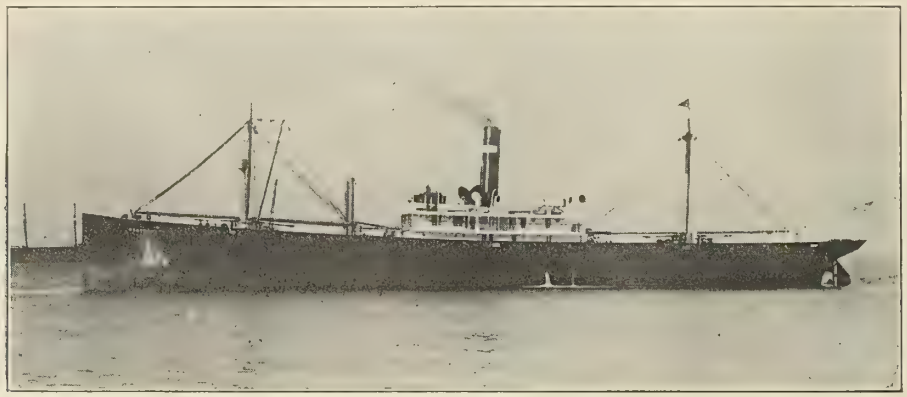
FOUNDRIES - - - { EAST BRAINTREE, MASS. GROTON, CONN.

New Vessels for the Porto Rican Service.

Steamships *Corozal* and *Montoso* have just been added to the fleet of the Porto Rico Line. The design and specifications for these vessels were prepared under the direction of Mr. Franklin D. Mooney, vice-president of the line, by Theodore Ferris, of Cary Smith & Ferris, the New York architects.

Length over all	347 feet 7 inches.
Length (Lloyds)	334 feet 5 inches.
Beam, molded	46 feet 9 inches.
Depth, molded to main deck	25 feet.
Load draft	20 feet.

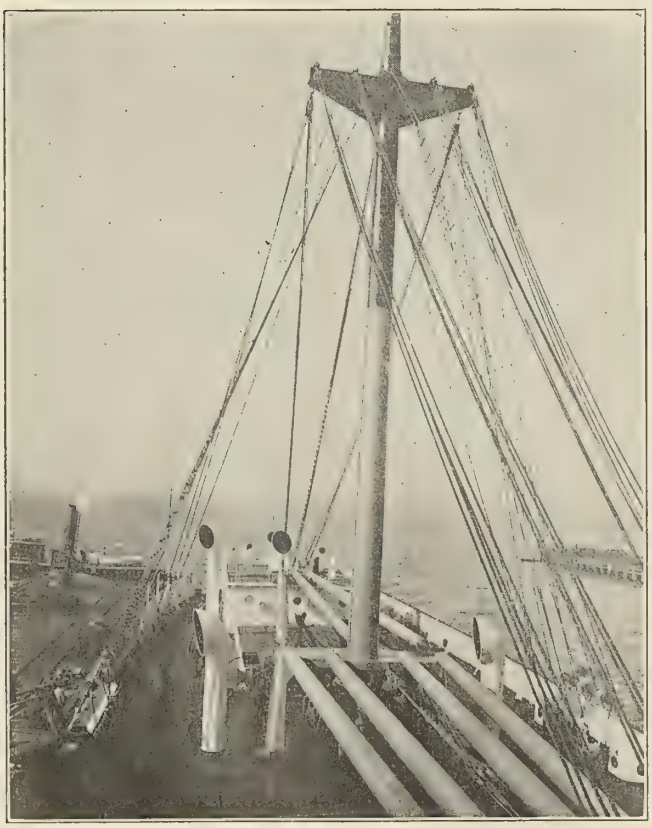
The vessels were built under special survey of Lloyds and to their highest class. They make a speed of 10 knots in service when loaded with about 4,700 tons deadweight. This speed is maintained on a consumption of 22 tons of coal per day. The vessels have a complete double bottom all fore and aft, a complete lower deck, and the main deck is flush with the steel bulwarks. There are two tiers of steel houses amidships, with teak pilot house above and a small steel house aft. There are two masts and two derrick posts, with a total of eighteen cargo booms, one of which is designed to handle 30-ton loads. The booms are served by eleven winches. Two of the cargo hatches have a length of 26 feet, two 23 feet 10 inches and one



A RECENT ADDITION TO THE FLEET OF THE PORTO RICO LINE

The vessels were built by the Newport News Shipbuilding & Dry Dock Company. The contract for both vessels was let on July 12, 1910; the keel of the *Corozal* was laid on September 28; the vessel was launched on December 31, and left the builder's yard on February 19. This is a record of 188 working days from contract to completion.

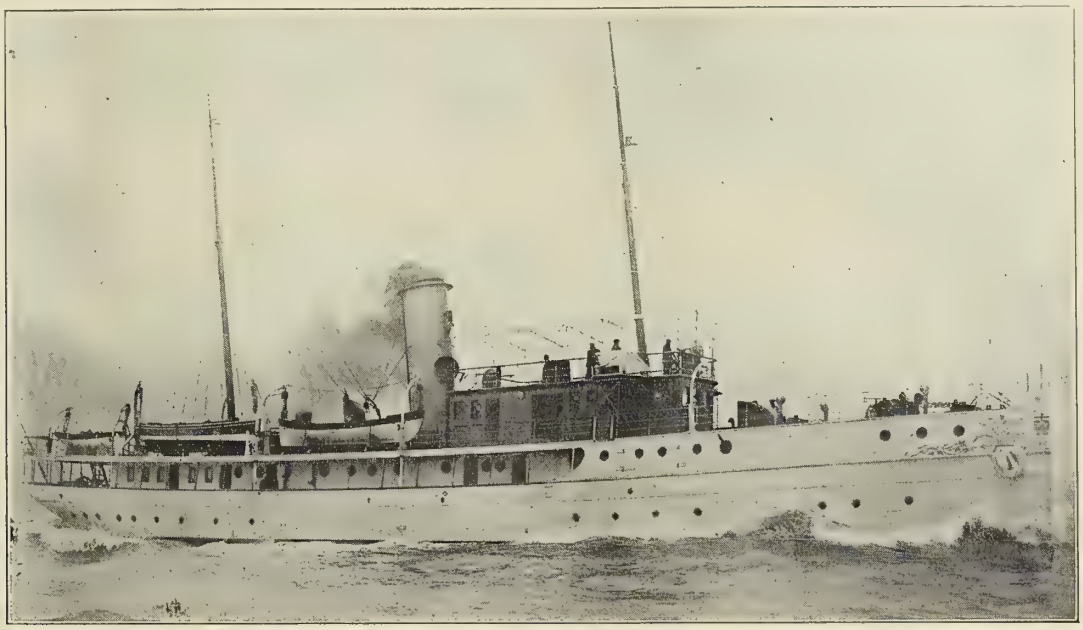
The vessels were designed for the sugar and general merchandise trade, with a steel lower deck, cargo ports, large hatches and a specially complete outfit of winches and cargo booms. The dimensions are as follows:



AFTER DECK OF THE MONTOSO.

FORWARD DECK OF THE MONTOSO.

13 feet. The beam stanchions are wide-spaced, with girders, and a watertight bulkhead is fitted to divide the fore hold. There are four cargo ports on each side for trucking freight from the lower deck. The machinery is located amidships, with a large cross bunker below the lower deck. The space between the lower and main decks abreast the machinery casings is arranged for carrying either coal or cargo. The total space under deck available for cargo is about 236,000 cubic feet. The officers have very complete quarters in the shipyard, and the detached pumps, except the circulating pump, together with the deck machinery, were built by outside manufacturers. The machinery develops about 1,300 indicated horsepower in service at sixty-nine revolutions per minute. A third vessel of identical design is under construction at Newport News for the same line, building under the supervision of the designers. The three pictures give an excellent idea of the general appearance of the vessels and of the unusually complete cargo-handling appliances.



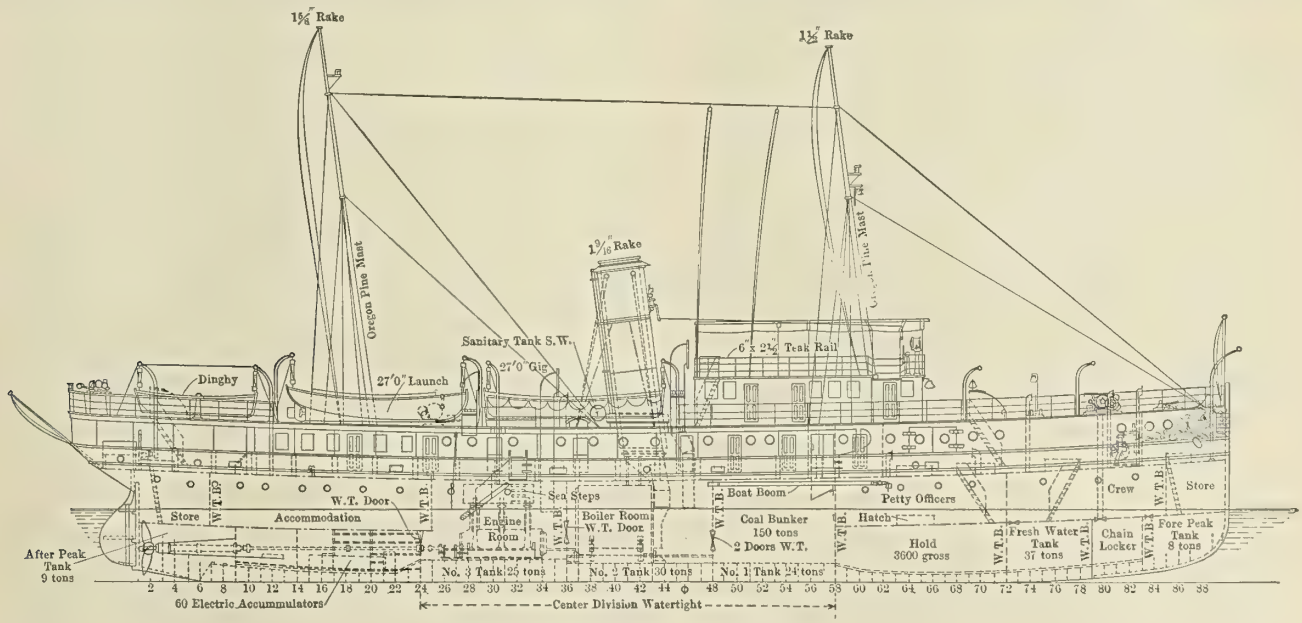
STEAMSHIP CARTIER RECENTLY BUILT FOR THE HYDROGRAPHIC SERVICE OF THE CANADIAN GOVERNMENT.

'midship houses. The firemen and seamen sleep in the after house and mess amidships.

The machinery consists of three single-ended Scotch boilers built for 190 pounds working pressure, natural draft, and one triple-expansion engine with cylinders 21½ inches by 36 inches by 63 inches diameter by 42-inch stroke. The steam auxiliaries are unusually complete. The propeller is of the sectional type with manganese bronze blades. In accordance with the general custom the main machinery was built at the

CANADIAN SURVEY STEAMER CARTIER.

The twin-screw steamship *Cartier*, built by Messrs. Swan, Hunter & Wigham Richardson, Ltd., at their Neptune Shipyard, Walker-on-Tyne, for the hydrographic service of the Canadian government, is illustrated in the accompanying engravings. The *Cartier* has been specially designed for survey work principally on the eastern shores of Canada, and in its design and equipment regard has been paid to the fact that on



GENERAL ARRANGEMENT OF THE CARTIER.

occasion voyages will be for long periods. The general particulars of the vessel are as follows:

Length	173 feet 6 inches.
Breadth	29 feet 1½ inches.
Depth, molded to upper deck	15 feet.
Gross tonnage	555.7 tons.
Net tonnage	234 tons.
Deadweight capacity	230 tons on 11 feet.
Displacement	1,035 tons.
Draft	12 feet 8 inches.
Service speed on trial	11½ knots.

The *Cartier* is fitted with twin-screw triple-expansion engines, with cylinders 11½ inches, 18 inches and 31 inches by 24 inches stroke; is supplied with steam by two cylindrical multi-tubular boilers, 10 feet 6 inches diameter and 11 feet 6 inches length, having a pressure of 185 pounds, and working under Howden's system of forced draft. As will be seen by a reference to the drawing there are many watertight compartments in order to ensure the safety of the vessel when in uncharted waters. On the lower deck, aft, is accommodation for the hydrographic staff, consisting of saloon, bathrooms, living room and four staterooms; and, forward, on the same deck is accommodation for the petty officers, seamen and firemen. On the main deck, aft, is a deck saloon and messroom for the hydrographic staff, with pantry and stewards' stores adjoining, and forward is the messroom for the navigating and engine staff, with pantry and stewards' stores and two staterooms for the second and third engineers and mate. In the forecastle side houses is wash-room and bath-room accommodation for the crew and petty officers on the port side, and carpenters' shop and coal storage on the starboard side, while immediately under the forecastle is storage room for gasoline in tanks. On the shade deck is a "Lucas" sounding machine, arranged on the bulwark rail on the port side, and towards the center, abaft the main mast, is a double-cylinder vertical sounding winch, constructed by Messrs. Clarke, Chapman & Company, Ltd., of Gateshead-on-Tyne. This winch has cylinders 5 inches in diameter and 6 inches stroke, and is fitted with whipping drum 9¾ inches in diameter keyed directly onto the crankshaft. The drum is fitted outside of the frame clear of the engine, while the other end of the shaft is fitted with brake hand-wheel. The winch has reversing valve, screw-down stop valve, etc., and is mounted on a cast iron bedplate with a trough cast on it to prevent oil and water running over the deck. Amidships on this deck is the chartroom and pilot-house, with bedroom and day room for the sailing master. The chart room, 15 feet by 7 feet, is fitted with a special drawing table, 5 feet by 10 feet, built in three thicknesses of pine, the front and frame being of oak. There is accommodation for a total crew of forty-three, including officers and engine men. The auxiliary machinery consists of a steam windlass (Clarke, Chapman & Company), steam and hand-steering gear, by John Hastie & Company, Ltd., of Greenock, and a refrigerating engine of the No. 3 single vertical marine (CO_2) type, by Messrs. J. & E. Hall, Ltd., of Dartford, Kent. There is steam heating throughout the vessel, and in all rooms and toilets, with the exception of those under the forecastle, are steam radiators, each having 25 square feet of heating surface for every 1,000 feet.

As the *Cartier* may be required to work in extremes of temperature, an elaborate system of ventilation has been introduced. In shallow water the staff of the *Cartier* will leave the steamer and conduct surveys in launches and boats, afterwards returning to the vessel to work up their observations. Accordingly, there are provided two gasoline (petrol) launches, each 27 feet by 6 feet 7 inches by 3 feet, as also two gigs, 27 feet by 6 feet by 2 feet 5 inches, and one dinghy, 18 feet by 5 feet 4 inches by 2 feet 2 inches. The steam winches, provided for the housing of the boats, are arranged with special leading blocks, so that they may be used for hoisting any one of the four boats. There is an electric searchlight on the bridge, and the other special outfit of the vessel comprises a standard compass of the Lord Kelvin navy pattern, while the steering compasses include a Ritchie standard compass and a Wilson & Gillie compass. The *Cartier* was built from the designs and under the superintendence of R. L. Newman, of Victoria, B. C., consulting naval architect for the Canadian government.

French Turbine Steamer Charles Roux.

The most notable feature of this new addition to the French mercantile fleet is her turbine machinery, the first to be installed in so large a French-built steamer. Her speed of 20 knots will reduce the cruising of the Mediterranean from Marseilles to Algeria very considerably. In fact, she will make the passage in twenty hours. The following are her general dimensions:

Length over all	400 feet 8 inches.
Length between perpendiculars	378 feet 5 inches.
Beam	45 feet 7 inches.
Depth	26 feet 2 inches.
Draft, forward	15 feet 1 inch.
Draft, astern	20 feet 4 inches.
Displacement, full load	4,610 tons.
Gross register	4,104 tons.
Net register	3,055 tons.
Indicated horsepower	10,000
Mean speed in service	20 knots.

Accommodations for passengers on this steamer are superior to those of *La Provence*. The hull is built of mild steel from latest improvements in order to obtain the highest rating in the French Bureau Veritas.

A double bottom has been worked from stem to stern, with a total capacity of 197 tons of water, which is quite sufficient to give the vessel the best trim. She is divided into eleven watertight compartments and fitted with watertight doors, which may be closed from the navigating bridge in forty seconds.

Vertically, she is divided by three steel decks, worked from end to end. The twin deck is used for third class passengers; the main deck for first, second and third class passengers and crew; the spar deck by the first and second class passengers only; the promenade deck is used exclusively by first class passengers.

The turbine engines are by far the most interesting part of the ship. They are located in a special watertight compartment, situated very far aft. They require considerably less room than the reciprocating type of engine, and are at the same time extremely simple to handle.

These turbines drive three propellers, 6 feet 3 inches in diameter each, with a pitch of 5 feet 7 inches, and they are run at 440 revolutions per minute.

The central propeller is driven by the high-pressure turbine, and the two outboard propellers are driven by low-pressure turbines.

Steam is supplied to the main engines as well as to all auxiliaries by eight cylindrical marine type boilers fitted with the Howden forced draft. They were built by the Chantiers de l'Atlantique, and the turbines were built by the Electro Mecanique Company of L'Bourget, Paris. The dimensions are as follows:

Length	11 feet 2 inches.
Diameter	16 feet 1 inch.
Number of furnaces	32
Grate surface	619

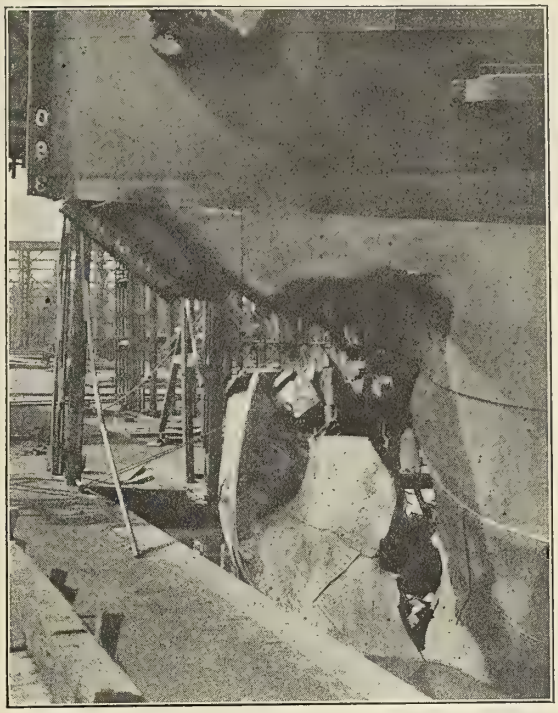
Heating surface ..... 23,710 square feet.
Working pressure ..... 157 pounds.

Two big funnels are used. The lighting throughout the ship is electrical, 900 lamps being provided. The air of all the compartments and the hold is renewed ten times per hour. Steam radiators are supplied throughout which are able to maintain under all conditions a temperature of at least 70 degrees F. Refrigerating apparatus is supplied in order to care for the fruits which are a large part of the cargo from Algeria. Most of the auxiliary apparatus is electric-driven.

Bow=on Collisions.

The result of a bow-on collision with an iceberg is shown by our illustration. The *Columbia* of the Anchor Line ran into an iceberg at a very slow speed during a dense fog, and while no lives were lost several passengers were quite severely injured, being thrown down by the impact. It is not hard to imagine what would have been the fate of the vessel if her speed had been even moderate. In this case the wireless apparatus was in working order, but the operator was unable to pick up for a considerable time either a ship or station. The value of strong bulkheads is most clearly evident here, as without them the accident might have been a catastrophe or even a mystery.

In the English Channel the steamers *Josephine* and *Dobrogea* collided, and we reproduce a photograph of the *Josephine's* bow. The plates on the port and starboard bow seem to have been most symmetrically forced back and the stem maintained its vertical position. The quick bend of the metal on the starboard bow resulted in cracking the material, as can be clearly seen. Neither of these vessels required assistance to make their ports after the accident, and here again the value of the bulkheads is made apparent.

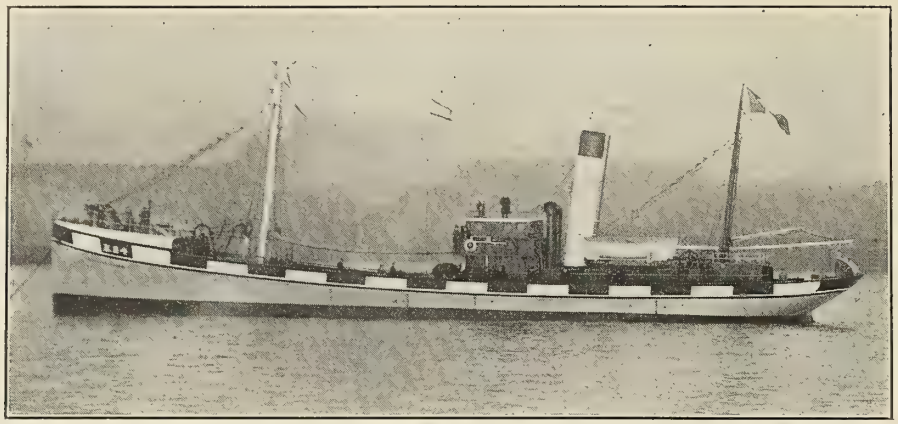


DAMAGE TO A LAKE FREIGHTER AFTER SINKING A STEAMSHIP.

In July the Great Lakes freighter *William Henry Mack* during a dense fog rammed and sank the steamer *John Mitchell* in Lake Superior. The accompanying picture shows the serious damage done to the bow of the *Mack*. She was hauled out for repairs in the yard of the American Shipbuilding Company. These illustrations show the local weakness of steel ships, but they emphasize the value of collision bulkheads when built sufficiently strong and watertight.

CRUMPLED BOW OF THE COLUMBIA AFTER COLLIDING WITH AN ICEBERG.
(*Photograph by Levick*)

BOW OF THE JOSEPHINE AFTER COLLISION, SHOWING CRACKED METAL.

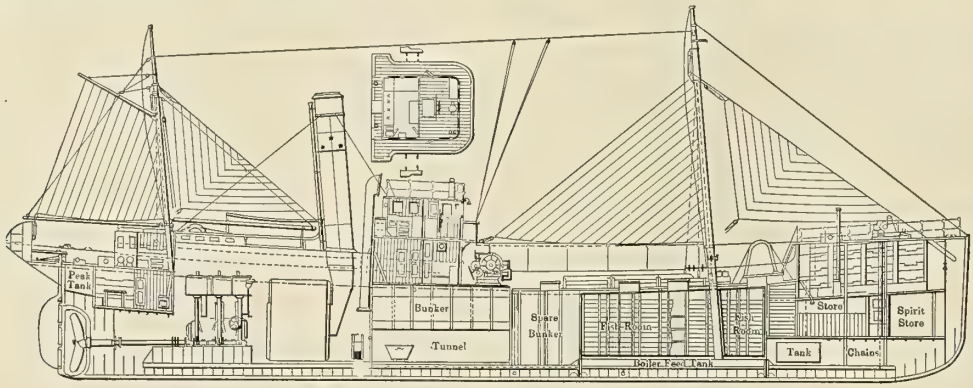


A STEAM TRAWLER FOR THE FRENCH NEWFOUNDLAND FISHERIES.

Steam Trawler Notre Dame des Dunes.

The steam trawler *Notre Dame des Dunes* was built for the French Newfoundland fisheries, and by Messrs. Cochrane & Sons, Selby. Her length is 160 feet; beam, 25 feet, and draft, 14 feet 6 inches. The engine with which she is fitted was built by Messrs. Amos Smith, of Hull. The cylinders are 14, 23 and 38 inches in diameter, the stroke being 27 inches. The boilers are of Scotch marine type, 14 feet 3 inches in diameter by 11 feet long, and carry a working pressure of 180 pounds. The steam trawl winches have great capacity, being able to carry 1,000 fathoms of warp on each drum, and all appliances fitted are of the best for deep-sea fishing. An electric light plant furnishes light for all hands, adding to the comfort of the officers and crew. The arrangement, as shown in the sectional view, is worthy of study. Great care has been taken to obtain an extremely large coal storage, necessitated by the vessel having to keep the sea for a long time. Two spare coal bunkers are provided, whose contents can be reached through a tunnel. The main coal bunkers extend aft on each side of the boiler-room to the engine-room, and forward of the engine-room completely across the ship between frames 31 and 47. The engine-room force is berthed just abaft the engine-room, but not on the same level as the engine-room floor, but above it. These quarters are comfortable and conveniently situated for those in charge of the engine-room. The crew are all berthed forward, while the officers are quartered amidships in the deckhouse.

A steam steering gear is fitted as well as an anchor hoist. It will be perhaps noticed by many that the deckhouse does not rake with the smoke stack and mast, which gives the vessel an odd appearance at first glance. This vessel fishes the Newfoundland water and also the waters near Iceland.

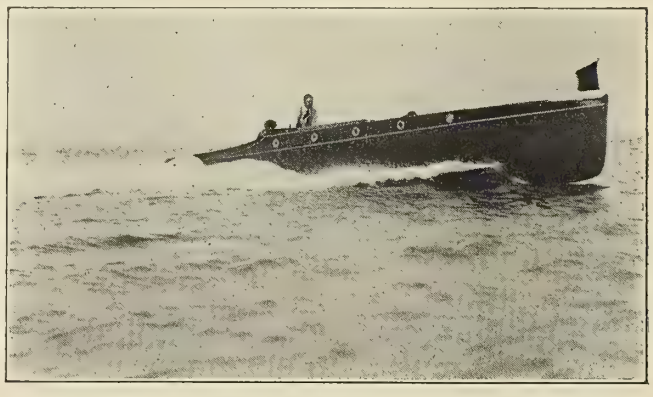


INBOARD PROFILE OF THE NOTRE DAME DES DUNES.

A Speedy Boat.

The motor boat *Tyreless III.*, built by Messrs. J. W. Brooke & Company, Ltd., Lowestoft, for Mr. F. Gordon Pratt, is one of the very interesting boats of the season. After she was launched there were only two days for tuning her up in preparation for the eliminating trials of the B. I. trophy. The boat made a speed of 30 knots, and the accompanying picture was taken when the boat was on her speed trial.

The hull of *Tyreless III.* was designed by Messrs. Cox & King, and was built by Messrs. Brooke & Company of mahogany. She is equipped with two six-cylinder, 150-horsepower Brooke engines, driving independent screws, one screw fitted below the other. That motor boats of this type prove to be most excellent sea boats is an interesting fact when it is considered they are designed for racing in comparatively smooth water.



THE TYRELESS III, CAPABLE OF 30 KNOTS.

PRACTICAL EXPERIENCES OF MARINE ENGINEERS.

Incidents Relating to the Design, Care and Handling of Marine Engines, Boilers and Auxiliaries; Breakdowns at Sea and Repairs.

How the Work was Done by "Coupling."

Editor International Marine Engineering:

The letters you sent me about how I repaired a broken crankshaft made me feel pretty good. I will do my best to tell how that coupling job was carried out as close as I can remember it.

I notice one letter goes into figuring, but I know enough not to get tangled up with x, y's and z's, and I accept one gentleman's idea that as the repairs stood all right there is nothing more to be said. As some one put it, "If a thing is too strong nobody finds it out."

In West Indian ports, as long ago as I made them, the repair shops were not fitted out for much more than a rough job. When I found the piece of shaft I looked over the shop and found a crank shaper. I think it was called a "Richards" or "Richardson" shaper. It had a long bed with two working rams and knees, but one had been "carried away" and only the knee was left, but this could be raised and lowered and fed along the bed. The knees were about 16 inches wide. The other tool needed was a 11½-inch lath; they call it a 23-inch swing lath in America. I hoisted the 12-inch length of shaft onto the shaper with a great deal of trouble. I managed to cut the shaft half through by using three lengths of parting tools. I then turned it half round and cut down through the other half. I took care in doing this so as to get a good straight face. I cannot remember just how long it took me to do this, but I think it was fourteen hours. I roughed out for the half-round. The most particular part in doing this was to get the sides parallel. The first side was easy enough, but the second half took a lot of care to set just right, as if I didn't get the width and depth in these slots just the same on both sides I would not get a good fit on my "half moons" or have the couplings stand square. The end of the shaft which I cut off I had put in a lathe, and the stub cut off and the flange faced up good and square. I then had a 6-inch hole bored through the couplings, and turned a 12-inch recess ⅜-inch deep in it. This was for the thickness of the metal I left between the end of the couplings and the slots. I could not go any further with this part of the work until I had the shaft end planed, as the lathe work only took about ten or twelve hours. I took the coupling out of the lathe and set four pieces of scrap iron ¼ inch the proper distance, and turned them off just so my 12-inch recess would slip over them. This brought the coupling absolutely true without any trouble. I can tell you, Mr. Editor, in doing all this work we just sweat blood.

It took a good deal of care when I got the coupling done to get the holes drilled in it just right, and one of them was off and I had to file it quite a bit. After I parted the coupling I clamped the parts together on an angle plate, and planed them off to a line.

It took about eight hours to fit the two halves of the couplings in place and to drill the holes. "I guess," as they say up in America, "most men would have done this job about as I have did it." I want to say that my "First" was a fine mechanic, and I wish I could remember his name to give him credit for much of the work on the job, and especially when it came to laying out and doing the finer parts. He always went by the name of "Rio," as we picked him up at that port.

Coupling.

Repairing a Broken Shaft.

Editor International Marine Engineering:

It seems to me that the repair of the broken shaft on the *Clara Belle* by "coupling" was an admirable trick. The incident is one of thousands which go to prove that the marine engineers are the ones who know how to do things. I believe that the repair is practically as strong as the 11-inch shaft; at least the mathematical treatment of the case confirms this belief, and nothing short of the actual test will ever prove which part of the layout is stronger than the rest.

The fundamental formula for torsion is $\frac{S\ J}{C} = P_v$, where S is the greatest stress per square inch, C is the distance from the center of the shaft to the center of gravity of the element farthest out, and J is a term called the *polar moment of inertia*. Without going into a mathematical demonstration of the origin of J, it can be taken by the reader simply to stand for that part of the resisting moment of the shaft that is the sum of the products of each little area or element of the shaft multiplied by the square of its distance from the center. Each square inch of the shaft offers a certain amount of resistance to torsion, and the value credited to each square inch will depend upon its location in relation to the center of the shaft. The letter J stands for a summation covering the entire area of the shaft, and the values of J for all standard forms are given in tables in engineering handbooks. For a solid circle $J = 1/32 \times 3.1416 \times d^4$, and for a rectangle $J = 1/6\ b \times d\ (b^2 + d^2)$.

By applying the principles explained above to our problem, we have

$$\frac{S\ 1/32 \times 3.1416 \times 11^4}{5\frac{1}{2}}$$

for the resisting moment of the 11-inch shaft, and

$$\frac{S_1 \times 1/6 \times 10 \times 6\ (10^2 + 6^2)}{\sqrt{5^2 + 3^2},\ \text{or}\ 6}$$

for that of the tang on the 12-inch shaft. Forming the ratio or proportion of maximum stresses in each part, we have

$$\frac{S}{S^1} = \frac{1/6 \times 10 \times 6\ (10^2 + 6^2) \times 5\frac{1}{2}}{6 \times 1/32 \times 3.1416 \times 11^4}$$

concentrating and reducing

$$\frac{S}{S^1} = \frac{2{,}720}{3{,}038},\ \text{or}\ \frac{S}{S^1} = \frac{27}{30},$$

approximately. This result shows that the stress in the 6 by 10 tang is slightly greater than the maximum stress per square inch in the 11-inch shaft. But it must be remembered that we have figured on only the 6 by 10 section, whereas there are some 7.7 square inches additional in the two segments at the ends of this rectangle. By taking the segments into account the value of J will be changed for the better; hence it is very likely that the tang on the end of the 12-inch shaft is as strong, or stronger, than the 11-inch shaft.

F. Webster.

Some Boiler Experiences at Sea.

Editor International Marine Engineering:

There is a little anecdote knocking around, but only partially believed, of a philosopher skipper of a coasting vessel who met with a nasty accident to his boilers. He broke it gently to his owners by telegraphing, "Cannot put to sea. Boiler gone out." His owners thought it was a case for the lunacy commissioners, but wired back, "Light the fires again." The reply was, "Cannot light fires. Boiler gone out through deck." While the experiences to be related are by no means so harrowing as this, they may contain points of interest to other engineers that will make them worth printing.

First of all, however, it may be said that looking after a boiler while at sea is by no means the same proposition as attending to the comforts of a steam installation on land. In the latter case there are usually plenty of tools of all sorts available, if not on the works at least within telephone call, and in case of serious trouble the makers of the boiler can be got hold of and renewal parts dispatched without much difficulty. On board a vessel it is different. Often the supply of tools is not excessive; the materials for repair beyond the ordinary joint rings, etc., have to be sought for, and often trouble occurs just when it ought not to, as heavy weather always finds out the weak places. Even if a vessel can be got to port it is as likely as not a few thousand miles from anywhere where engineering supplies can be bought cheaply, and where, probably, there is nothing to speak of in the way of an engineering shop in the whole place. For this reason the marine engineer is thrown very much on his own resources. Some of the jobs he makes of repair work are crude if effective, until one takes account of the materials and opportunities at his disposal. Then they are oftentimes marvelous.

In one case the top of the boiler round about the main stop valve had become badly corroded and very thin. The cause of this in the first place was due to allowing the gland of the stop valve to leak. This had caused the covering to be worn off the boiler near the valve and corrosion had set in. Ultimately the boiler gave out while steam was being raised. On examination it was found that a considerable area had been affected by corrosion, so that a piece was cut out of the bad plate measuring about 2 feet by 1½ feet. A piece of steel plate about ½ inch thick was found on board, and this was cut down to about 2½ feet by 2 feet. It was then heated and hammered until it was brought as near to the curve of the boiler shell as possible, and holes were then drilled through the boiler shell ¾ inch diameter by about 2½ inches apart. The plate was then put through into the inside of the boiler, and the holes marked off on it while it was in place. After drilling it was bolted and hammered up into its place, afterwards being riveted with rivets made of the best Swedish iron. These rivets, by the way, had to be made on board from bar-iron, as no rivets were procurable. When the riveting was complete, the plate was securely calked, the valve was replaced, and the part where the patch was being lower than the boiler shell, owing to the plate being on the inside of the boiler, was filled up with cement and smoothed over in order to prevent any water lying on the boiler. It was not, perhaps, a pretty repair, but it served its purpose.

Very nasty occurrences can happen owing to improper treatment of boilers. They may stand it for some time, but eventually there is the devil to pay. Some engineers, for example, when giving orders to light the main boiler fires, light the middle ones only, and leave the wing fires until the next morning. They then wonder why the boiler begins to leak at the seams on the bottom. A little consideration will show that the top will be hot, under such circumstances, long before the bottom is heated up, and therefore unequal expansion will follow, with the inevitable result of leaky seams. The proper way to treat a boiler is to light all the fires at once and to keep on circulating until the steam is fully up. A marked difference in the state of the seams will be found with careful treatment of this kind.

Another thing in the treatment of a boiler which requires careful watching is the use of mysterious compounds known as boiler fluids. Some of these are good, others are not; even with the best of them they ought to be treated as physic and given to the boiler in measured doses. Reckless use of such materials may easily lead to serious trouble. On one occasion a Fox tube, forming the center furnace of a boiler having three furnaces, collapsed suddenly, and the cause of the collapse was found to be owing to the reckless use of such a boiler fluid. This liquid was supposed to bring the scale off the water-side of the heating surfaces, and the chief engineer used the fluid in unduly large quantities. The result was that so far as the small tubes and the tube plates were concerned, the scale was brought off most effectively, and the same action occurred on the tube crowns of the wing furnaces. The unfortunate part about it was, however, that all the scale ran down upon the crown of the center furnace tube, with the result that it became overheated and laid down for a rest upon the fire-bars. As soon as the occurrence was discovered the dampers of the faulty boiler were at once closed, and steam was taken off the boiler by opening the engines full out, putting the cold-water feed upon the other boiler and running the ballast donkey pump. As soon as it was safe to do so the boiler with the damaged furnace was shut off until the collapsed furnace tube had been built up hard and solid with fire-bars, firebricks, scrap iron and anything else safe and handy. Then the other two fires were set away in the boiler, which was then only worked with the wing furnaces. The voyage was completed by using steam at a reduced pressure, and the danger of too much boiler fluid was amply demonstrated.

One rather lively experience in connection with a boiler furnace tube shows the inadvisability of thinking that they will work forever and a day. In one old steamer a piece of metal about 1½ inches wide and 2½ inches long blew out of the center furnace tube, which was plain, slightly above the line

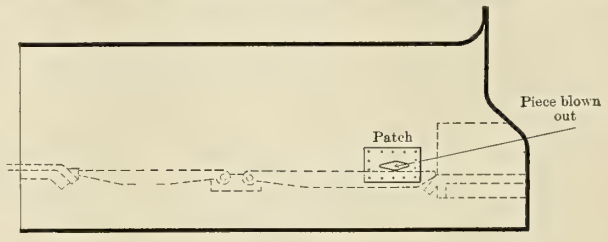


FIG. 1.

of the fire-bars and a little in front of the bridge, as shown in Fig. 1. The engineer on watch when the occurrence happened, on hearing the noise (which was considerable), went to the stokehold, but could see nothing but steam. He could, however, hear plenty of water flying about. He therefore went back to the engine room and had a look at the gage glasses. He found that the water was rapidly going down in the port boiler, and therefore put the extra feed full on, shut the other check down in the remaining boiler, opened the engines out, shut the main damper, and got the donkey feed pump under way as well. By this time the chief engineer had got to the scene of action, and together they made an attempt to get into the stokehold, but they had to come out again in a hurry. Of course, they knew that the trouble was located in the port boiler, and as soon as the steam got right back they shut this boiler off. They eased the safety valve and blew all

the steam off, the vessel stopping. As soon as this was done they succeeded in getting into the stokehold, from which the firemen had escaped, one with a very bad scalding. The place presented a rather disorganized appearance, as the furnace had no fire-bars in and everything loose had been distributed round the stokehold. Steam was got up again in the starboard boiler, and the ship proceeded again at half speed on one boiler, while the hole in the port boiler was repaired by putting a patch on the inside of the furnace tube, as shown in the first sketch. The patch was secured by ¾-inch bolts, and to stop the fire from burning the double thickness of plate which was now on the furnace tube, due to the patch, the bridge was built further out so as to come over the bolt heads and so protect the weak part. Steam was then got up again, and the repair carried the vessel safely to port. The cause which led up to this piece blowing out was that pitting had gone on to a very considerable extent at this point and trouble was expected, though not to such an alarming extent. It should be said, by the way, that the joint between the patch and the furnace tube was made with Portland cement and gauze wire. The way the repair was effected may not recommend itself very much to the aristocrats with unlimited engineering means at their disposal. The "classy" way of effecting a repair on a furnace tube would be to bevel the hole, and then bevel the plate which forms the patch. Then the patch should lie on the fire side, and thus, theoretically, there would only be one thickness of metal. But the practical marine engineer who attempts to make the repair in this way while the vessel is at sea is either an extraordinarily clever fellow or else he has bitten off more than he can chew.

Another instance of first-class trouble in a boiler due to apparently insignificant causes can be related. In this case the wrapper plate of the combustion chamber of a boiler became

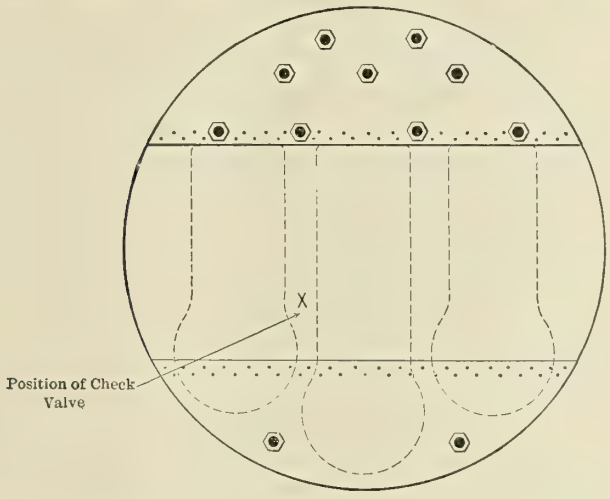


FIG. 2.

holed owing to the way the feed-water impinged upon it. Fig. 2 shows generally the way in which the boiler was arranged with the position of the check valve on the end of the boiler. Fig. 3 shows more clearly the shape and general arrangement of the internal pipe leading from the check valve into the boiler. It will be seen that this internal pipe was screwed on to an extended spigot which passed through the hole in the boiler plate back of the check valve flange. This internal pipe, as originally fixed in the boiler, was arranged to stand in an upright position, but in course of time it became loose on the screwed spigot and turned round till it hung downwards. This caused the water to be discharged into the boiler in a stream, which impinged onto the wrapper plate of the combustion chamber. The result was that the local action of the cold feed water upon the hot plate soon weakened the latter, and ultimately this weak part was blown out. The repair of this failure necessitated the blowing down of the boiler and waiting till it was cool enough to enter. The hole was then patched with a plate on the fire-side, the bolts being put through from the water side and the nuts being therefore on the fire-side of the plate. The task of getting this plate bolted up into place will be seen to have been no easy one, when it is considered how all the small stays of the boiler got in the way of the engineers while at work. When the job was done the internal pipe was secured

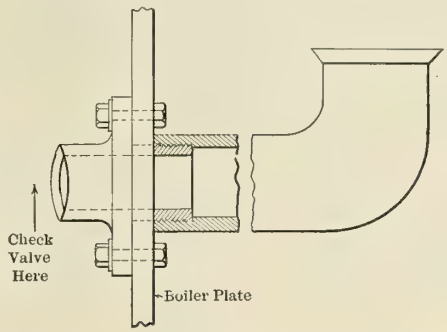


FIG. 3.

in its proper position so that it would not turn round again. This pipe was about 18 inches long, and stood in between the two combustion chambers, the back plates of the combustion chambers being about 7 inches off the back of the boiler. The wrapper plate was holed in the plain part a little distance from the cover seam.

A little negligence goes a long way towards causing trouble in connection with a boiler, and the firemen need to be carefully watched in this respect. A word may be said regarding the habit of leaving the hot ashes on the footplates near the boiler. This is a very bad practice indeed and should not be allowed on any account. Apart from the danger to boiler doors the front plates of the boilers in time become burnt, necessitating expensive repairs. Moreover, if the ashes are cooled by throwing sea-water over them, and the ashes allowed to lie there in this wet state, one of the best ways of starting external corrosion of the boiler plates will have been indulged in, and this practice will sooner or later involve disaster if it is not noticed in time. An instance where a repair, which, although of a minor character, is sufficiently typical, occurred through the firemen allowing the clinkers to remain on the footplates after cleaning the fires, is illustrated in Fig. 4.

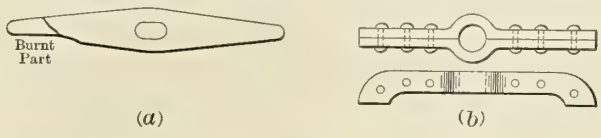


FIG. 4.

In this case the trouble was located in the dog of a boiler man-hole door. This was on the bottom boiler door, and in the stokehold, and the firemen allowed the clinkers to remain, covering the door. The result was that the dog got burnt to the shape shown in the sketch (*a*) and the engineer of the vessel rightly considered it unsafe, in its weakened state, should there be a vacuum formed in one of the boilers when the steam was off. It, therefore, became necessary to extemporize a new dog as shown in plan and elevation in (*b*) by bending two pieces of iron to the shape indicated, drilling 1-inch holes through them, and then riveting the two pieces together. This made a good strong dog.

Trouble does not always occur in the main portions of the boiler. The smallest details have to be watched as well. This was shown in a happily little experience which occurred

with a salinometer cock. The engineer one day went to open the cock in one of the boilers to draw some of the water in order to take its density, and to his surprise the cock flew out of the shell as soon as it was turned, as the thread in the gland nut had stripped. The engineer found the cock again and, at the expense of being scalded to some extent, he managed to get it into place again by holding it over the shell and giving it a sharp tap with a hand hammer. He then hung on to it and held it down in its place until one of the other engineers arrived and bound it down with some copper wire. In order to make a permanent job of the matter, two small plates were cut, as shown in Fig. 5, and these were arranged with two 5/8-inch bolts and nuts so that they braced the parts

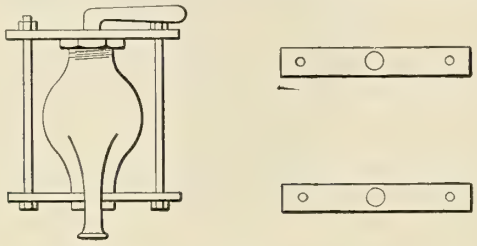


FIG. 5.

of the cock together, as shown in the illustration. This arrangement left the cock so that it could be worked in the ordinary manner without danger.

Every engineer with sea-going experience will know the great difficulty which is experienced with the packing of boiler fittings, so far as the material used is concerned. It is oftentimes a most tedious and difficult matter to deal with a refractory stuffing box, so far as the trouble of getting the old stuffing out is concerned. The packing has often to be cut and chipped out with a hammer and chisel, as it becomes, in contact with water, hard with encrusted salt and in addition is baked solid with the heat of the boiler and stokehold. The amount of time taken up by chipping and picking the old packing out is enormous, and it is to be feared, if one may go by the unpleasant appearance in some stokeholds of leaky glands with great lumps of salt sticking to them, that the job of repacking is sometimes shirked when it ought to be attended to without delay. One engineer, impressed with the trouble and annoyance in connection with the use of ordinary packings, made the experiment of trying lead as packing for some of the stuffing boxes of his boiler mountings, and he found that the idea worked splendidly. In order to pack a stuffing box, he first cleaned it out thoroughly and then carefully rubbed the valve spindle and stuffing box over with some black-lead powder on every part which would be covered by the lead. He then ran the stuffing box up to a certain distance with molten lead, leaving sufficient room, say a quarter of an inch, for the gland to enter. When the gland was put on and tightened down, it was packed in a way which lasted for years without any further trouble. The only thing necessary when opening or shutting the valves was to slack the gland back a little before beginning the operation, and to tighten it up again after the valve had been turned. With the heat of the boiler the lead was kept somewhat soft, but, of course, never obtained its melting point, which is between 400 degrees F. and 500 degrees F., as the boiler water did not reach that temperature. This method of packing is not to be advocated indiscriminately for every gland to be found on a boiler, as some valves, such as the main check valves, are constantly being worked, and such a packing would not be suitable. Where, however, valves are only used intermittently, say once or twice a week, such as, for example, the scum valves, blow down valves, etc., this form of packing gives excellent results, and may be recommended to sea-going engineers with confidence.

In conclusion, it need hardly be said that these notes do not pretend to cover or even hint at the range of possible breakdowns which may occur on a marine boiler. Unfortunately, the variety of trouble which can happen with a boiler is almost endless, and a book could be written on this subject alone. The above remarks are, however, typical of some of the things which a marine engineer has to look out for, and if they stimulate other engineers to contribute their experiences on parallel lines they will have served their purpose.

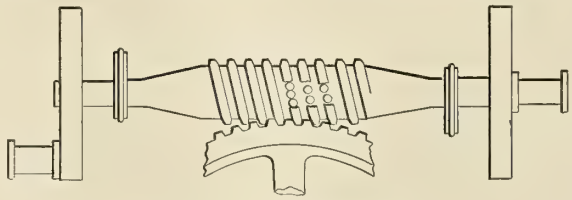
AN OLD CONTRIBUTOR.

Broken Worm of Steering Gear Engine Shaft.

EDITOR INTERNATIONAL MARINE ENGINEERING:

An old friend of the writer once told him that if he wanted to form an opinion as to the way an engineer on board of a vessel looked after his machinery he did not go first to the main engines, but to the auxiliaries. He argued that the main set was the show piece, and anyone worthy of his salt would keep that right; but the small details of the auxiliary gear were what tested a man's capacity for thoroughness and strict attention to every item that might lead to trouble. There is more in this view than some people suppose, and very frequently most harassing difficulties arise out of apparently unimportant parts of a ship's machinery. The moral of this is, that the fourth engineer, who is usually told off to look after the auxiliaries, requires just as careful watching as the second and third.

In addition to this, owners of vessels very frequently fall into the mistake of trying to economize on the auxiliaries. They will buy a set of main engines with due regard to their performance, but any old thing will do for the donkey pump if it is cheap enough. It would hardly be thought that this would apply to such an important part of a vessel's equipment as the steering gear, but it sometimes does. For example, it is the writer's opinion that, as a general rule, the worms and the worm wheels of steering gears do not receive as much oil as they should. Some makers take care of this point, but others do not. The result is far too rapid wearing on the worms, and eventually considerable trouble.



BROKEN WORM STEERING GEAR.

If the worm wheel is a vertical one a very good plan to avoid a lot of bother due to this cause is to make up a small oil bath out of galvanized iron sheet of a suitable shape to encase the lower portion of the worm wheel. By keeping this supplied with oil, the oil is carried up to the worm with the revolution of the wheel and an immense amount of wear is saved. It will be found that the worms always wear much more quickly than the worm wheels, and for this reason due regard should be paid to the class of oil used. It is advisable to use a good thick, heavy oil, as light oil is of no use. A very good plan to give good results is to take ordinary marine engine oil and make it properly thick by melting white lead and mixing this with the oil.

The sketch shown herewith gives a rough idea of what happened to the worm of a steam gear engine shaft. Owing to the worm having worn thin it got broken, due to the back-lash which occurred on the worm wheel attached to the chain drum. This back-lash was caused by the rudder lashing about from side to side in heavy weather, and, therefore, the accident

occurred at a most inconvenient time, as most accidents do. Incidentally it may be remarked that the heavy strains thrown on the chains, drum and worm wheel are often not appreciated. When the rudder is put hard over these are tremendous, so that proper supervision should be given to them. In this case, when the worm broke, the engine jammed itself and stopped. As repair was urgent, a series of ¾-inch tapping holes was drilled in the shaft with the holes close to each other, and in such a manner as to run in line with the worm. These holes were then tapped and ¾-inch studs were screwed tightly in. They were then chipped down to the same dimensions or profile as the rest of the worm. The repair fortunately held good throughout the voyage, although heavy seas were encountered, and got the vessel home without further difficulty.

At Sea. The Fourth Engineer.

Mending a Cracked Shaft.

Editor International Marine Engineering:

When I first read about a turbine boat I was oiling on a tramp. Now I am the chief of a tramp. Just after I got this position I made a certain English port, and heard the steamship ——— was there, which was fitted with this new style of engine, and I made a straight line for it. I had the good fortune to find a man aboard who had been shipmate with me on two voyages, so I got into the engine room without much trouble, and met another old friend (a shopmate) who was doing some repairs. I took a look around, but those round, barrel-shaped affairs with everything inside of them "looked good to me," as the boys say, and I had about made up my mind that all the troubles of an engineer were at an end, and all that we would have to do in the future would be to turn on steam and "let her buzz." I told Jake, that was my old shopmate, my idea. Now, Jake was a Scotchman with the English name of Lynn. He hand only one eye, and he took a look at me out of that one eye and drawled out, "When you ken a turribinne," and that is as near as I can write down how he pronounced it, "you'll bide in the ship where you are." I got a taste of that later; but I didn't start out to tell about turbines but the repairs to a shaft.

No matter whether you've got a turbine or any other kind of an engine, I suppose we'll always have to have shafts. I show a repaired shaft in the drawing herewith, and I want to tell you, Mr. Editor, that the drawing looks a good deal better than the job, and it's a good deal easier to make the drawing than it was to do the job.

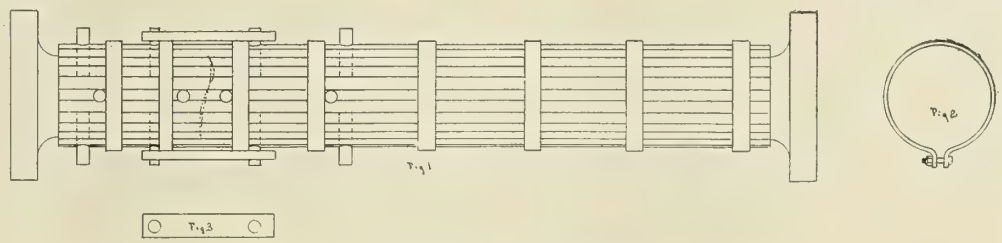
A short time after this visit to the turbine ship I picked up my old shopmate, the Scotchman, pretty drunk, up in Montreal, and for old acquaintance' sake took him aboard my ship as an oiler, and after one trip I took him into the engine room. On my next trip South the first length of the shaft just abaft the thrust cracked, and we discovered it just in time to shut down for inspection and consideration. I knew we had a lot of bar steel on board, and I sent Lynn down to break it out so we could see what we had. He reported there was a lot of 1½-inch square steel about 16 feet long. Now the diameter of my shaft was 12½ inches, so I figured it out that our area of shaft was 122.7. Of course, I could not patch up that shaft so that it would be just as strong as a solid one; but if I put in sixteen 2-inch pins, each with an area of 3.14, I would have about 50 square inches. I started some of the oilers with hack-saws cutting off the 1½-inch bars, so that I could get them in between the couplings and not have them right on the fillets, and I started Lynn and some other men with ratchets drilling 2-inch holes about as shown on the drawing. We drilled them about 4 inches deep, and by shifting the men often we finished these holes in a little over fourteen hours.

I had a small lathe on board, and I cut off from some round stock which was 2¼ inches, and roughed them down to 2 1/32 inches, and as soon as I could caliper the drilled holes I turned the pins down so they fitted good, leaving them sticking out about 3½ inches. I drove these pins in with a light sledge; then I laid the 1½-inch square steel around the shaft, holding them in place temporarily with some small chain we had on board, and it was quite a job to get them in place. Of course, the 1½-inch stuff didn't run perfectly straight or even, and when we came to the last length next the pin I had to do some filing, so as to let the length come in nice and snug.

Before I drilled the holes I got some 4-inch stuff by 1½ inches which we had on board, and cut off two lengths, as shown in Fig. 3. I drilled the two end holes. After I got one of the holes next the crank drilled and the pin in, I put one of these pieces over the pin and used the other end as a jig to drill the second hole. I did this with the second piece, with the idea that this would hold the shaft together; that is, if it gave away it would not back off, and I found this held all right.

Among the firemen I had a man who was a pretty good smith, and he turned up out of some stuff, which was 2¼ by about ⅝ inch, some clamps, shown in Fig. 2. These we drilled in the lathe, and after we got all the 1½-inch stuff nicely set round the shaft we started to spring these clamps around them, and this we found a good deal of a job; in fact, it took a whole lot of time; but we managed to get them on, and passed a bolt through them. I think we put in two, but I do not remember that, and we had the job done, and old man Lynn, when he looked at it, said it put him in mind of one of those old-fashioned things the Romans used to carry about with an axe stuck in the top. But bad as the job looked we thought it was pretty solid, but as we had some ¼-inch wire cable we wound some of this around the bundle to make sure, and we started up very slow, and made our West Indian port about a day and a half late. Of course, there is small chance of getting anything done in the way of a new shaft down there, and as the job seemed to be holding we started in ballast for an American port and made it all right. But the success of this was too much for Lynn, and he, finding a Scotch friend by the name of Whiskey, the first time he went ashore, landed in the lockup, and I guess he is there yet.

Kingston, Jamaica. H. S. G.



METHOD OF REPAIRING A CRACKED SHAFT.

Mr. William Rowland, for many years connected with shipbuilding in New York waters, died July 21 at Spring Lake, N. J., his summer home. His death marks the passing of a type of man to whom the shipbuilding world owes much.

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Whether a community of people are in a ship afloat or in a house ashore, their nature remains the same and the condition in which they have been brought up naturally affects their action. Afloat there exist conditions which bring men closer to each other than those ashore. It is clear that at sea one must do for all and all for one. A very little thought will explain this reason of closer relationship.

Before steam was known there was absolutely no possibility of a division of responsibility throughout a ship. Every order came from the captain; it was carried out by a man trained in exactly the same condition as he. What one said was in a language that had developed from the sea. When, however, steam came this condition changed. Here was suddenly introduced a set of men who did not have the same line of thought or training. Their language differed. "Valves and cylinders" meant nothing to the captain; "port and starboard," "luff and fill" meant nothing to the engineer. It was, therefore, natural that this condition produced friction. The captain saw his skill, obtained by long years of training, becoming less and less valuable, and the self-reliant feeling bred of thorough knowledge grew less and less until the ship seemed to be under the control of another.

The knowledge required to guide a ship from port to port and to handle her under the conditions of storm is of no mean order. The sailorman had to go through a severe and long apprenticeship, and he has always commanded the admiration of the world. What is the outlook to-day? What is to be done? Are all seafaring men to become engineers, or are all engineers to become seafaring men? Or, again, are we to reach such a state of mechanical perfection that there will be no further need of any great intelligence in handling machinery on board a ship? Do not some of the later engineering developments point rather strongly to leaving the high-grade mechanical brains on shore? We have the turbine, which when it goes out of business at sea is apt to stay so. Makeshift repairs seem to be out of the question. From the bridge of a new collier the geared turbines are to be controlled without the intervention of any engineer. The gyroscopic compass may hold a ship on its course more steadily than the best quartermaster to be found. Liquid fuel is changing the fire-room from a glowing seething mass of light and sweating humanity to a room in which are easy chairs. To-day if you buy a cheap watch it is guaranteed for a year, and if you take it back to-morrow on account of some trouble you are handed out a brand-new one and the watch is returned to the factory for repairs. Is it not possible that there will be no repairs whatever at sea? With twin screws every vessel can limp into port, and it can easily be imagined that mechanical things can be so perfected that what might be called a fool-proof system will be worked out, and that every possible condition can be anticipated. The captain of the future ship will be more and more of a mechanician and the mechanician of future ships will be more and more of a sailorman.

The action of the State of Connecticut in respect to the port of New London is important and ought to be far-reaching as to its influence. It is the first movement of comprehensive harbor marine engineering in America. It provides not merely for expert engineering construction, but that which is of greater interest—intelligent operation.

For years International Marine Engineering has urged more scientific development of harbor and dock work, which is so carefully studied and practiced in Liverpool, Antwerp, Hamburg and elsewhere. But for some reason American steamship agents and owners have clung to old methods and have ignored tangible and substantial evidences of up-to-date methods which we have again and again shaken in their faces, as it were. The port of New London has the opportunity to place itself far ahead of New York, Boston and every other American port as the proper place for steamships from all parts of the world to discharge their cargoes expeditiously and economically and reload correspondingly.

LEGAL DECISIONS REGARDING MARINE WORK.

Injuries from Bursting of Boiler Tube—Necessary Inspection.

A suit in admiralty was brought by the fireman of a steam schooner against the owner for damages for personal injuries sustained by him by the bursting of a water tube in one of the schooner's boilers, resulting in the almost total destruction of one of his hands. The ground of recovery of damages was the alleged neglect of the owner and officers of the boat to keep its watertubes in proper condition. The evidence showed that the tube was overheated, and the trial court found that this was caused by the accumulation of scale or some similar substance in the pipe, whereby the circulation of the water was impeded, resulting in the reducing of its thickness by burning to the bursting point, and that the officers of the schooner were negligent, either in failing to make such inspection as would disclose the existence of the deposit or to take proper steps to remove it if discovered. On behalf of the schooner it was urged that the injuries were caused by a latent defect in the pipe. There were two boilers in the schooner, each of which contained sixteen 4-inch and more than three hundred 2-inch tubes. Expert evidence was given by a government boiler inspector and a marine engineer in the employ of the makers of the boiler in question, tending to show that the bursting was caused by a latent defect in the iron. On behalf of the libelant the exploded tube was put in evidence as an exhibit. It showed that it had been overheated and burned from some cause, and there was testimony tending to show that the cause was neglect on the part of those in charge of the schooner to keep the tubes properly cleaned out. Upon such evidence the court considered it would not be justified in interfering with the conclusion reached by the trial court, and affirmed a judgment for the libelant.—*Maritime Inv. Co. v. Hanos, Circuit Court of Appeals, Ninth Circuit.*

Damage to Cargo from Leaking Pipe.

In a suit in admiralty for damages sustained by a cargo of grain delivered in damaged condition through contact with water while in the hold, it appeared that the water dripped through a crack in the main feed pipe, which extended about 9 feet through the cargo space between the engine and the boiler. The vessel was built eleven years before the accident, which happened in 1905, and had been repaired in 1904. The position of the feed pipe was not unusual in vessels constructed for service on the Great Lakes. She was rated A-1, but after this controversy arose her rating was reduced. The pipe was covered with asbestos. It was inclosed in a wooden box. The pipe was of wrought iron ¼ inch thick and 2½ inches in diameter. Although such pipe comes in lengths long enough to bridge the distance which it ran through the cargo space, two lengths were coupled, not quite midway, but nearer the boiler-room bulkhead. Each length was threaded and screwed into the coupling. After the damage was discovered the pipe was stripped. It was found to be cracked at the bottom of one thread at the edge of the coupling. The crack went just through the pipe, probably three-quarters of an inch long; but the pipe was not broken off. A thorough inspection of the pipe could not be made while the asbestos and the boxing remained on. The last inspection with the covers removed was in 1904, when the vessel was being repaired. The weather encountered was rough, but not unusual at the season of the year (October). It was held that the vessel had not sustained the burden of proving that the leak resulted from a "danger of navigation" within the exception of the bill of lading. Whether the leak resulted because a seaworthy pipe was exposed to some extraordinary strain, or because pipe, weakened by age and by some incipient crack which had developed since its last thorough inspection over a year before, gave way under strains which were to be anticipated, and which would not have broken a seaworthy pipe, could not be said upon the proof. The decree for the shipper in the district court was therefore reversed and the case remanded for further action.—*The Rappahannock, Circuit Court of Appeals, Second Circuit.*

Construction of "Inchmaree Clause" in Marine Insurance Policy.

The owners of a steamship claimed to recover for an average loss under a policy of marine insurance on the hull and machinery of the vessel. The policy was for twelve months against the ordinary Lloyd's perils; and it also contained the clause known as the "Inchmaree Clause." For the purposes of the present case the directly relevant words of this clause are: "This insurance also specially to cover * * * loss of or damage to hull * * * through any latent defects in the * * * hull * * * provided such loss or damage has not resulted from want of due diligence by the owners of the ship, or any of them or by the manager." There was a defect in the ship's stern frame. This defect was covered up by the makers. During the currency of the policy the defect became visible owing to the ordinary tear and wear, and the stern frame was condemned. The assured claimed to recover under the policy the cost of replacing the condemned stern frame. It was held that there had been no loss or damage to the hull, and therefore that the assured could not recover.

The introduction of the "Inchmaree Clause" into marine insurance policies followed an explosion which damaged the machinery of the *Inchmaree*, either through a valve becoming salted up or by the valves being closed by negligence of the engineers. The House of Lords in Thames and Mersey Marine Insurance Co. *v.* Hamilton, Fraser & Co. (3 Times L. R. 764; 12 App. Cas. 484), held that such a damage was not recoverable either as a peril of the sea or under the general words in a Lloyd's policy. "Inchmaree Clause" was introduced to give the protection denied by this decision. It covers the negligence of servants, explosion and bursting of boilers, and it covers loss or damage through latent defects.

In the court's view what is recoverable under the quoted part of the "Inchmaree Clause" is: (1) Actual total loss of a part of the hull or machinery, through a latent defect coming into existence and causing the loss during the period of the policy. This was the kind of latent defect alleged in the *Inchmaree* case. (2) Constructive total loss under the same circumstances as where, though the part of the hull survives, it is by reason of the latent defect of no value, and cannot be profitably repaired. (3) Damage to other parts of the hull happening during the currency of the policy, through a latent defect, even if the latter came into existence before the period of the policy. The pre-existing latent defect itself is not damage, indemnity for which is recoverable, even if by wear and tear it becomes visible during the policy.—*Hutchins Bros. v. Royal Exchange Assurance, 27 Times L. R., 217 (K. B. Div.)*

Construction of Steamer for Government a "Public Work."

An action was brought under the act of August 13, 1894, Chap. 280, 27 Stat. at L. 278, as amended by the act of Feb. 24, 1905, Chap. 778, 33 Stat. at L. 811, U. S. Comp. Stat., Supp. 1909, p. 948, upon a bond given to the United States, as required by the act, to secure a contract by an engine works to build and deliver a single-screw wooden steamer for the United States. The main question in the case was whether the

statute applied to a contract for a steamer, or, in other words, whether a steamer is a "public work" within the meaning of the statute, which gives any person who has furnished labor or materials used in the construction or repair of any public work, which have not been paid for, the right to intervene in a suit upon the bond, and is intended, besides securing the United States, to protect persons furnishing materials or labor for the construction of public works. The court held that a steamer is within the statute. By article 3 of the contract in question, partial payments were provided for "as the labor and materials furnished" equaled certain percentages of the total. By article 4, "the portion of the vessel completed and paid for under said method of partial payments shall become the property of the United States," although the contractor remained responsible for the care of the portion paid for. By article 2 there was to be a final test of the vessel when completed. The vessel had been built and accepted, and was then in possession of the United States. Notwithstanding this it was argued that the statute did not apply to the contract, because the laborers and furnishers of materials had a lien by the State law; and that, even if the statute applied, they had lost their rights by not asserting them before the delivery of the vessel, as before that, it was said, the title did not pass to the United States. But the recent decision in United States v. Ansonia Brass & Copper Company, 218 U. S., 452, establishes that the title to the completed portion of the vessel passed, as provided in article 4, and that the laborers and material men could not have asserted the lien supposed to exist. The court did not consider itself bound to read the words "any public work" as confined to work on land. The fact that the bond was not executed until ten days after the contract was signed did not make it without consideration, as the transactions were practically simultaneous. And the assignment of some of the claims did not affect the remedy.—*Title, Guaranty & Trust Co. of Scranton v. Crane Co., United States Supreme Court.*

TECHNICAL PUBLICATIONS.

Engines and Boilers. By W. McQuade. Size, 5½ by 8½. Pages, 87. Illustrations, 62. London: G. Bell & Sons, Ltd. Price, 3/6.

When it is remembered that Mr. McQuade uses but 87 pages to outline boilers, engines, internal-combustion engines and steam turbines, it can be easily seen that but a mere skeleton of the subjects has been presented, but this skeleton is one on which the flesh of further knowledge can be indeed well applied. The author does not pretend to furnish a book the reading of which will result in one becoming an engineer, but he most admirably starts a student in that direction. The illustrations used are admirable. Not a single superfluous line is to be found in any of them, and they really look like drawings such as are made by competent draftsmen and engineers. We regret that at times there is a misuse of names of articles, and this should be corrected in the next issue, as, for instance, on page 5 there is an assertion that the "junk ring is held in place by set screws." Now, set screws are not used for any such purpose, and this is misleading to the student, as is the statement that the starting valve on a locomotive is called a "regulator;" this is found on page 60. We have never heard this appliance called anything but a throttle valve. We do not think the author has been personally and practically in charge of engines or he would never say as he does on page 9 that "the wear at the crosshead pin (connecting rod) is slight." For the student we recommend the book, and we consider it to be extremely interesting to many people who merely take a passing interest in mechanics, as many things in engineering which now seem blind to them will be made clear.

Railway Shop Kinks. By Roy V. Right. Size, 9 by 11¾ inches. Pages, 290. Illustrations, 803. *Railway Age Gazette,* New York-London. Price, $2.00.

No matter who bought this book of Mr. Right's they could not turn a page without learning something. Many might say that the "kinks" shown are old. That may be true, but we do not all know them, and there are a lot of these "kinks" that seem new, at least to us. The International Railway General Foreman's Association, in solemn conclave assembled, passed resolutions in due form to have this book published, and we are all going to be better off for it. We would, therefore, offer in return the following resolutions: That whereas "Railway Shop Kinks" is a valuable book, full of practical information, and whereas knowledge is money in its most valuable form, be it resolved, that the readers of this notice order a copy at once.

Fighting Ships. By Jane. Size, 7¾ by 13 inches. Pages, 548. Illustrations, endless. London, 1911: Sampson Low, Marston & Company, Ltd. Price, 21/ net.

To those who have had any experience in collecting data this publication will awake their admiration. The work is admirably well done. It must be remembered that in making up such a remarkable volume it is with infinite difficulty that certain details, and even generalities, concerning vessels of war are obtained, and absolute accuracy cannot be hoped for, but we are fair when we judge a work by what we personally know, and in turning to fighting vessels which are well known to us we find the detail strictly correct. It is a source of wonder to us, however, that the work can be made to pay, as the cost must be very large and its sale somewhat limited, but there is hardly a publication that has ever come to our knowledge which is more thoroughly interesting from end to end than is this one. A treaty of peace between Great Britain, France and the United States has been debated, and yet the guarantee of such peace must be found in the power to enforce the agreement, and that power lies almost exclusively in the fighting ships of the various nations. To be able to turn to any vessel and find out dimensions, speeds and other valuable information is not only of great interest but of the very greatest convenience, and every naval architect with military inclinations certainly should have this work.

Valve Gears. By H. W. Spangler. Size, 6 by 9¼ inches. Pages, 179. Illustrations, 109. New York: John Wiley & Son. Price, $2.50.

Mr. Spangler asserts that the designing of valve gears is entirely a drawing board process. In all but radial gear, and even in them, this is true to a great extent. He has adopted the admirable system of taking the data of engines that have been actually constructed to illustrate and expatiate on. It does not seem as if there is anything new on the interesting subject of valve gearing, and yet here is put forth in a much more concise way than is usual the results of the labor of many who have given the study of valve gear the closest attention and who have become so thoroughly allied with the subject that their names are synonymous with its study. If the readers have no book on valve gear we know of none which it would be so wise to purchase as this, and if he does buy it and reads it, "marks, learns and inwardly digests" it, he will thoroughly understand valve gear.

Marine Gas Engines and Their Construction and Management. By Carl H. Clark, S. B. Size, 5¾ by 8 inches. Pages, 115. Illustrations, 102. New York: D. Van Nostrand Company. Price, $1.50.

This particular field seems to be pretty well supplied already with books of this character, and in reading it over we do not find any new presentation either in construction or management. Primarily, we should judge the author's idea is to help those who are running engines rather than those who are con-

structing them, and in this it ought to be successful and a help in many cases.

Answers on Refrigeration and Ice Making. Two volumes. By Gideon Harris. Size, 6 by 8½ inches. Pages, 1,059. Numerous illustrations and tables. New York and London, Theo. Audel & Company. Price, $2 each.

A book of this kind is most convenient for the man who has actual charge of refrigerating machinery, and is also most admirable for all refrigerating engineers to have at hand to turn to. The most insignificant details are carefully noted and explained and illustrated. In many cases the information is given so that the man who is in a great hurry to know just what to do and how to do it can immediately obtain it. The advantages and disadvantages of various systems of refrigeration are made plain, and the temperature at which various products should be kept is clearly set forth. It is self-evident that the writer of the book, Mr. Gideon Harris, is fortunate in his selection of assistants who aided him in making up the book, and the refrigerating world is much better off for their work. If there is one thing to criticise it is the index; but it is a grave question whether it is possible to index a book of this kind so that it could be used to the best advantage until one is thoroughly familiar with it. This is largely accounted for by the line of thought of those who will use the book, but after a very short time we believe that almost anything connected with cold storage and refrigeration can be sought for and found within the covers of the book. It certainly, at times, does not waste words, and this is a very decided advantage; for instance, the question is asked, how much ceiling space is needed? the answer is, "½ inch." Here is a gem.

An excellent table or log is laid out for use with refrigerating appliances, so that what is done can be carefully recorded with a view to bettering conditions from week to week. In short, the work is an addition, and a valuable one, to the literature of refrigeration.

Lloyd's Register of American Yachts. Size, 9½ by 7¼ inches. Pages, 468. Forty-five colored prints and supplement. New York: Lloyd's Register of American Yachts, 17 Battery Place. Price, single copies, $8.50 and $7.

This is the ninth edition of the *Lloyd's Register of American Yachts,* and in it is shown the increased predominance of power over sail boats, the proportion of power craft being even greater than last year. Many important additions to the yacht world were made last year, among them the schooners *Enchantress, Elena* and *Karina.* The first, designed by Cary Smith & Ferris, is Class 100 A-1, and is the latest advance in yacht construction. The *Karina,* designed by Theodore D. Wells, is designed for off-shore cruising. The *Elena* is a racing schooner. The *Enchantress* and *Karina* are sailing yachts, but fitted for the ultimate installation of gas engines. One of the most notable additions to the list of yachts is the *Sovereign,* designed by Charles L. Seabury. *La Belle II.* is a steel yacht fitted with triple screws and designed by Cox & Stevens. In the smaller divisions of sailing yachts the additions are limited to 31 feet and smaller classes. The power division, however, includes many new cruising yachts of all sizes from 100 feet down, practically all equipped with gas engines. The *Register* has been slightly enlarged in the last year and thoroughly revised and all the old yachts dropped out. The list includes over 3,500 vessels, 472 yacht clubs and 31 associations within the limits of the United States, Dominion of Canada and the West Indies. The burgees of 456 clubs and associations are given. Estimating closely, there seem to be at least 600 yacht clubs within the territory mentioned. There are the names of 3,300 owners of yachts, with their full address whenever it could be obtained, together with the clubs to which they belong. Yacht builders and yacht designers, also engine builders, builders of yacht equipment, are listed most completely, as well as the manufacturers of miscellaneous fittings for yachts.

Marine Engine Design. By Edward M. Bragg, S. B. Size, 6½ by 8 inches. Pages, 172. Numerous illustrations. New York: D. Van Nostrand Company. Price, $2.

There is much concerning the design of engines in this book which is put in a clearer form than usual. It is evident that the book is the result of a want felt by an instructor. The details of construction are shown, and there are to be found tables which are most convenient to have for ready or quick reference. In commenting on the turning and reversing engines, and giving data for their design, we think the author would find that there is a wider diversity in this respect than anywhere else arising from a fact he did not mention; *i. e.,* that such engines are made usually with very small bearings, as time of operation is never long—in fact, rarely more than a few minutes; consequently small bearings are admissible, and, as a matter of fact, a good many engine builders in making these turning engines are apt to take any design that they happen to have and cobble it up so as to make something which will do the work with comparatively little attention to refinements. We recommend the book to all interested in marine engine design. It is a reprint of the excellent articles which appeared in our columns.

Praktischer Schiffbau Bootsbau. Size, 7 by 9½ inches. Pages, 327. Illustrations, 328. Issued by the Akademischen Verein Hütte, E. V. Berlin: Wilhelm Ernst & Sohn.

This work goes into the construction of small boats in a very practical way. It also devotes a part of its pages to the description of motors and various kinds of propellers and boat appliances. It also touches on racing shells. The usual painstaking German characteristic is clearly shown in the minuteness of the details given, and many of the drawings are most interesting of the sail boats as well as the motor boats.

Cold Storage, Heating and Ventilating on Board Ship. By Sydney F. Walker, R. N. Size, 5½ by 8 inches. Pages, 269. Illustrations, 70. New York: D. Van Nostrand & Company. Price, $2.00.

In this book, which was reprinted from previous issues of International Marine Engineering, there is no attempt to go into the details of the mechanical apparatus used for refrigeration on board ship. It wisely devotes its pages to the use and application of the various systems now generally employed for refrigeration, and these are most clearly described. The most commendable feature of the book is that of discussing the "faults," as the author calls them, commonly known as "troubles," and giving solutions which will rectify them. The method of operating each system is not perfunctorily entered, but all the explanations are practical. It must be remembered that refrigeration at sea is a comparatively new development, and the value to seafaring men and their personal comfort and the great value to the world at large have not been really thoroughly appreciated.

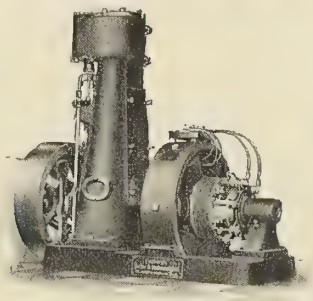
Blue Book of American Shipping. Sixteenth edition. Size, 7½ by 10 inches. Pages, 408. Numerous illustrations and tables. Price, $5.00.

The Blue Book of American Shipping has reached its sixteenth annual edition. It contains its usual list of vessels, drydocks, shipbuilding concerns, as well as the names of the heads of the various government bureaus, and this list of names is most valuable for those who are bidding or are carrying on business with the government in its various departments. The additions of vessels during the past year are entered, and we note that hereafter the publication will be issued biennially, which will enable the list to be corrected to a closer date than heretofore.

ENGINEERING SPECIALTIES.

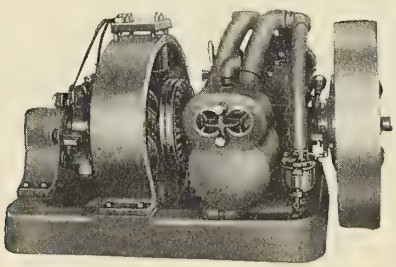
Compact Electric Lighting Sets.

While undoubtedly the controversy concerning isolated plants will continue for some time, the Engberg Electric & Mechanical Works, St. Joseph, Mich., seem to have settled the question concerning a compact, reliable and neat electric light plant, and they do not confine themselves to making these plants for steam only, but for internal-combustion drive as well. They make them from 2½ kilowatts, running at the moderate speed of 625 revolutions per minute, up to 10 kilowatts, running only 350 revolutions; in internal-combustion engines they make, not only a vertical outfit, but one with cylinders set directly opposite each other, thereby saving head room. These plants are made as small as 1½ kilowatts, running at 625 revolutions per minute, and weighing but 525



pounds. The generator which is fitted to these prime movers is made by the company, and is most compact and yet rugged. In the smaller electric sets, run by gas engines, a revolving field is used which does away with the fly-wheel, reducing weight and making a very compact outfit. The steam engines are entirely self-lubricated, and the governing is right up to the requirements of the present day. The internal-combustion engines are fitted with the splash oiling system throughout.

In connection with these generating sets the Engberg people make a line of searchlights in three sizes, or rather two sizes, 8 inches and 10 inches; but the 10-inch is made for marine work as well as land work, and, consequently, has certain features which are only valuable for this class of work.



An automatic cut-off is provided in these lamps, so that no damage will be done if the operator neglects to pull the switch when the carbons are consumed. This is a feature, we understand, possessed by no other searchlight, and certainly is a most valuable one.

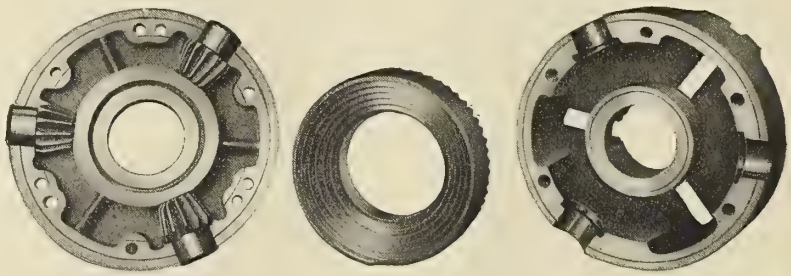
Dermatine Valves.

The quality of material used in the mechanical part of a machine is of importance, but it is by no means all of it, as, if the material is not properly applied or used trouble results. "Dermatine" is a substance which is made by the Dermatine Company, Ltd., 93 Neate street, London, S. E., and is used for valves of all kinds. The nature of this substance is not explained in the catalogue, but its value is clearly shown, and most useful hints are given therein as to how valves of both

the rigid and flexible type can be best applied. Numerous illustrations are given of practical forms of valve guards and grids, and their improved anchor bushing for valves, which we illustrate, is described, and by their use leaks in air pumps are greatly decreased.

The "Columbia" High-Speed Universal Chuck.

The universal chuck, manufactured by Messrs. Schuchardt & Schutte, 90 West street, New York, grew out of the demand created by the heavy cuts which can be taken with high-speed steel. Let us say right here that the designation of chucks is very apt to lead to confusion. The universal chuck, such as shown in the illustration, has jaws which work to and from the center simultaneously, and this word "universal" is often misunderstood and ordered where the combination chuck is wanted, the combination chuck being one in which the jaws can be made independent of each other in action or can be set



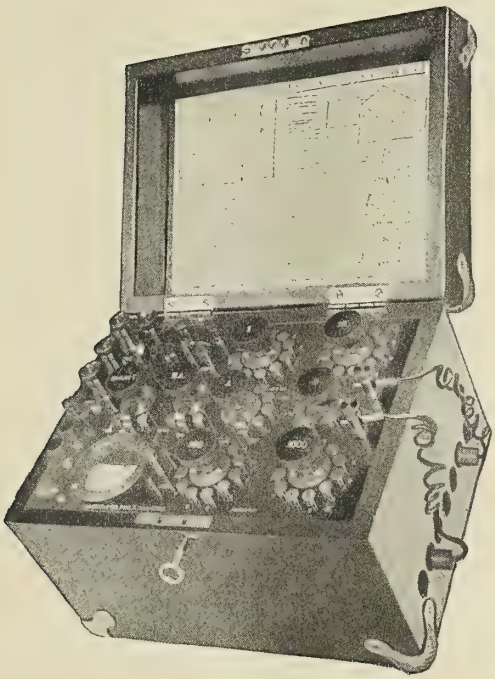
in any position from the center and then worked simultaneously in combination, while the third style of chuck is called "independent" where each jaw is actuated by a screw so they cannot be worked simultaneously.

The peculiarity of the "Columbia" is that the jaws slide on an incline, which gives a much larger wearing surface for the scroll, and a finer pitch of scroll can be used, which, of course, gives additional holding power and far greater wearing surface, so that the chuck can be used on a single diameter for a great length of time without the jaws becoming loose in that particular position. This chuck is not adapted for holding rings or any article which should be held from the inside by

expanding the jaws. They are made from an outside diameter of 3⅛ inches holding a 4-inch piece up to 16 15/16 inches, holding a 16-inch piece. This is an unusual range for a chuck, and yet the maximum size of work can be held absolutely firmly.

Queen Portable Testing Set.

The principal applications of the portable testing set aboard ship as made by Messrs. Queen & Company, of Philadelphia, are the checking of conductor resistances in dynamos, motors, starting boxes, etc., the measurement of moderate insulation resistances, the location of crosses, grounds and opens, the checking of ammeters and voltmeters, measurements of capacity and inductances and other determinations dependent upon the electrician's knowledge of the fundamental principles involved and his skill in applying them.



The installation of this instrument aboard ship evidences the advances made in electrical apparatus equipment. The outfit becomes a standardizing laboratory, capable of manipulation and accuracy by those who may not be skilled in the use of measuring instruments, and makes it possible for the ship's electrician to carry out those tests essential for maximum efficiency.

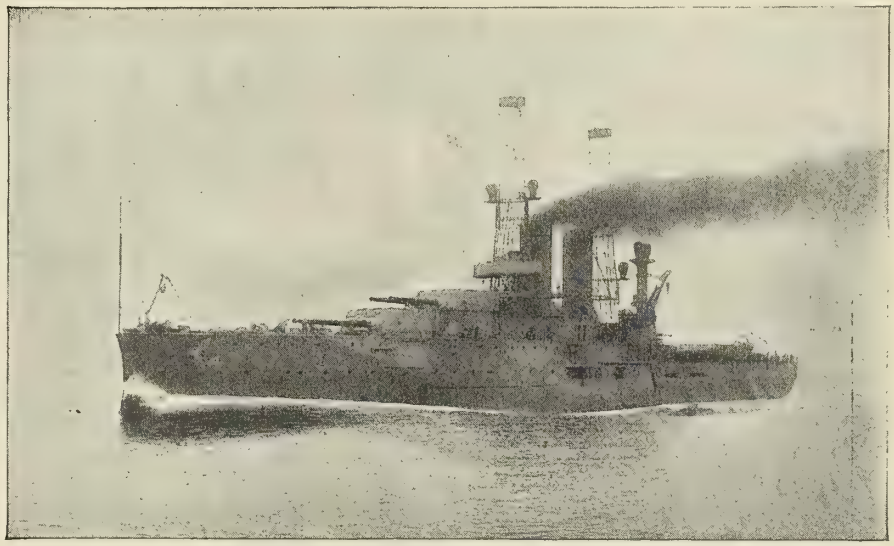
The instrument illustrated is the Queen Dial Decade Portable Testing Set. The dial, a switch pattern, provides a somewhat quicker method of manipulation than a plug. The construction of the switch is such to insure permanency of contact, and provision is made so that it can be taken apart for inspection. The galvanometer is of the D'Arsonval type, uninfluenced by proximity to dynamos, and is balanced to minimize the effect produced by the rocking of the ship. The battery consists of ten cells placed in a block; each individual cell can be placed in circuit. Provision is made for connecting an external battery, so that the instrument is never useless by reason of its cells becoming exhausted.

The lid is provided with a special gasket and hasps, so as to prevent the salt air from getting into the interior of the set. All interior steel and iron parts are heavy nickel-plated, and the resistances specially treated to prevent deleterious action of the sea air.

Battleship and Yacht Blowing Outfits.

The United States battleship *Utah* and the seagoing yacht *Aloha* are fitted with "Sirocco" fans. In the case of the *Utah* twelve forced draft sets are used, four in each of three blower rooms, each equipment consisting of 30 inches diameter by 30 inches wide "Sirocco" wheels, driven by 31-horsepower electric motors, and each capable of delivering 22,000 cubic feet of air per minute. We are informed that these fans, displacing the above volume of air with a total of 264,000 cubic feet of air per minute, have rotors the combined volume of which is but 147 cubic feet, the fans thus handling a volume of air in cubic feet per minute equivalent to 1,800 times their own volume.

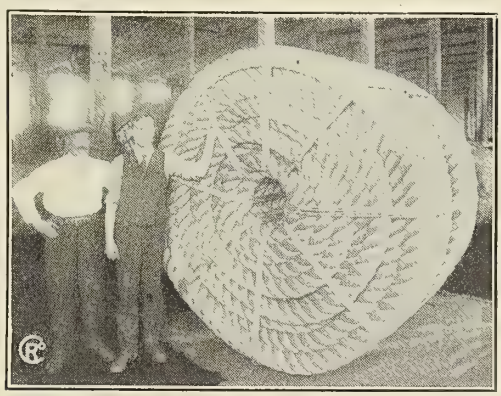
In the yacht *Aloha* one small fan 15 inches in diameter, driven by a direct-connected motor, is ample to produce sufficient draft for all needs, with ample margin against necessity, producing 6,000 cubic feet of air per minute total, or 8,000 times the volume of the wheel.



The *Utah* on her trial trip made over 21 knots with but nine fans in operation. On the four-hour trial run she easily maintained her speed. The entire twelve fans were run at below their maximum rated speed for coal only.

Some Rope.

The accompanying picture is a coil of rope made by the Columbian Rope Company, Auburn, N. Y. The coil stands 8 feet high and is 8 feet across. It contains 1,200 feet of continuous rope. In the coil are thirty-two bales of the best manila hemp. The rope is made in three strands of 510 threads each. The great weight of this coil and its exceedingly

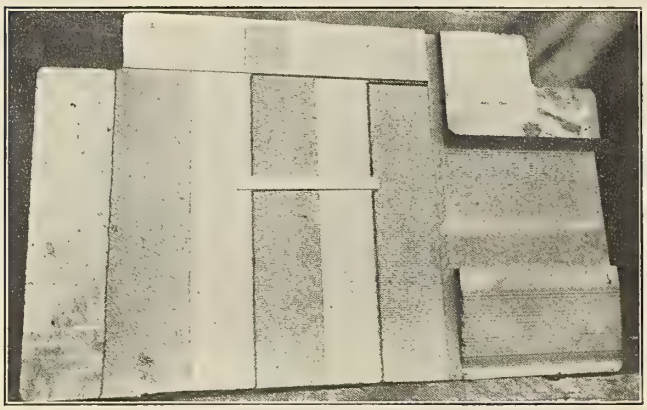


large size made it necessary to charter a special freight car in order to ship it. The rope is 15 inches in circumference, and the full coil is 200 fathoms. It was made on order for the United Fruit Company.

Reversing Motor Drive.

There is little doubt but what the planer has pretty nearly reached its maximum size if driven with belts. The difficulty arises from the fact that in order to get the enormous power required for the quick return of a very heavy platen, high speed of belt drive is not alone necessary, but width of belt is also demanded, and this gets so cumbersome that to shift a wide belt became practically uncommercial. Four belts were resorted to, which helped matters some, but when the introduction of the electric motor began, and finally was selected as the means of an individual drive for various machines, it was not to be wondered at that the motor drive was first used in connection with belts, but of late, both abroad and in the United States, a great deal of money has been expended and a tremendous amount of experimenting done with the reversing motor drive.

The illustration which we give is a slab which was worked up on a 76-inch "Pond" planer driven by a 30-horsepower reversing motor. The load on the table was 17,000 pounds.



The illustration does not clearly show just the conditions of the work. The 12-inch scale, which lies on the piece, gives a fair idea of the dimensions of the piece planed. The extreme left portion, which is shown as being smooth up, with a very wide cross feed, is in a higher plane than any of the other parts, numbered 1, 2, 3, 4 and 5. It is, therefore, to be noticed that in planing No. 5 the tool dropped into the clearance space and planed up to an absolute stop, which is the point at which part No. 4 started. It is to be noticed that this line is practically straight. The next step, No. 4, was taken with a different feed, and it in turn brought up against a shoulder which formed the right-hand edge of No. 3, and so on. The part marked No. 6, of course, had ample room to the right for the tool to start in its work, and it ran out in the clearance space at the end of the cut, but it is to be noted that the feed of this plane portion, No. 6, varied. This was done while the planer was in motion. The square part, marked No. 7, is a depression, the tool digging in at one end and running up against a shoulder at the other. This, of course, is not an operation that would often be required and would hardly be looked upon as commercial, but it is extremely illustrative of the wonderful control which this reversing motor drive places in the hands of the operator.

The whole secret of the matter is that at the instant of reversal, when the leading or pilot switch comes in contact with the shifting dogs on the table, the controller short circuits the armature, creating therefore considerable resistance, which causes the motor to become a generator, consequently a most powerful electric brake. The cutting speed is shifted at any time the operator desires by merely moving a little contact button, while the feed can be varied in the same way and under the same conditions, and the control of the motor is such that there is practically no overload and no wide fluctuation of the amount of current to be supplied from the line. This is a most interesting point. The Niles-Bement-Pond Company, New York, handles these tools in its own shop.

COMMUNICATIONS.

Terminal Improvements at the Port of New London.

Editor International Marine Engineering:

The State of Connecticut has appropriated $1,000,000 (£200,000) to improve the terminal facilities at the port of New London. The act provides that the State Commissioners "shall have full power on behalf of the State to acquire, own, construct, maintain and operate docks, wharves, piers, quays and dykes, canals, slips and basins, or any other appropriate harbor facilities, sheds, warehouses of all kinds, vaults, railroad tracks, yards, terminals and equipments and all other land and water transportation facilities in the city of New London necessary to expedite the interchange of rail and water traffic."

The cost of handling miscellaneous cargo freight between vessel and shore is one of the most important factors in influencing cargoes to go to any particular city. A differential of 2 cents (1d.) per ton in favor of a city on a large cargo of bulk freight would influence its going to that city, other conditions being equal. By installing the latest and most improved mechanism, under expert advice, so that miscellaneous freight can be properly handled, there will be effected a saving of at least 15 cents (7½d.) per ton, or including both the loading and discharging, total saving of more than 30 cents (15d.) per ton. On a 5,000-ton cargo, this would be $1,500 (£300) in favor of the city having the modern equipment. Besides the reduction in the cost of transference, rapidity is necessary.

The charter value of a freight steamer of medium size is about $400 (£80) per day. For every day saved, by rapidity in loading or discharging, there is over other cities not equally well equipped also a differential in favor of that particular city. If two days can be saved, $800 (£160) would be to the credit of New London to attract commerce.

To show to what extent machinery has been used at foreign ports, at the Kuhwaeder dock alone at Hamburg there are installed around this dock 134 traveling elevated gantry cranes costing over $500,000 (£100,000). Under the control of the harbor authorities at Hamburg there are about 1,000 cargo-handling cranes, and every active port in Europe is equipped with similar machinery.

The development of the city of Antwerp is highly corroborative of my statements that as well-equipped terminals are provided the traffic of the city and State expands. In 1850 the tonnage was only 200,000 tons. In 1909 it was 11,940,332 tons from sea navigation and 8,169,754 tons of interior vessels. Antwerp was visited by 6,135 vessels in 1908. The increase of the population of Antwerp has been equally remarkable with the commercial increase.

Most of the large ports in Europe have been equipped with machinery for ten or twenty years, and some are even now installing hydraulic machinery instead of the far superior electric. Reference is not made to them as examples to be

exactly copied, but as illustrating the great necessity of not neglecting mechanical methods. The cost of lifting package cargoes from the ship's hold upon the edge of the pier may be 6 cents (3d.) per ton, but to assort and distribute throughout the transference shed, or to the cars, would be at least 28 cents (14d.) additional. Machinery can now perform these movements at a cost of 14 cents (7d.) per ton. Provision should also be made for economically transferring bulk cargoes.

Take the two cities Liverpool and Bristol, between which there was a struggle for supremacy. Bristol did not expend the money for improvement, although it had equal natural advantages. Liverpool did, and to-day Liverpool is one of three great ports of the world. The Liverpool docks compose a large part of the city front and cost $200,000,000 (£40,000,000). Twenty-six thousand vessels in one year visited Liverpool, with a registered tonnage of 17,000,000, and the total tonnage, inward and outward, was 35,201,767 tons. These vessels pay dock, harbor and tonnage rates. The revenue for the year ending June, 1911, was $6,899,000 (£1,379,800). London is another interesting example of the danger of neglecting terminal facilities. It neglected to keep abreast with the demands of commerce, and within a few years awoke to the fact that Liverpool, Hamburg, Antwerp, Amsterdam, Rotterdam and other ports had wrested from it a large amount of its foreign commerce. It has now commenced the expenditure of $83,000,000 (£16,600,000) to recover, if possible, its former position.

New London is splendidly situated to become one of the great ports of the United States. On account of its close proximity to the sea, easy approach and a rich hinterland, largely interested in manufacturing, with excellent railway connections, even to Canada, there is every reason to expect a great increase, if there is an open gate terminal through New London to the markets of the world. The Thames River is tidal for several miles. In 1900 there was a traffic movement of 464,283 tons. In 1907 reports show: Coal, 190,304 tons; lumber, 5,177 tons; steamboat freight, 486,566 tons; miscellaneous freight, 150,921. Total, 697,139 tons. Among the transportation companies which do business in New London are: New England Navigation Company, the Thames Transportation Company, the American Lighter Company, McWilliams Bros. Montauk Company (L. I. R. R.), Fishers' Island Navigation Company.

On the 4 or 5 miles of frontage on the Thames River at New London the city at present owns practically nothing. It maintains merely a right to a ferry slip and one or two small dock privileges at the ends of streets. Practically all the water front is owned by private parties and corporations. The wharves and the most desirable front belong to the railway and steamship lines. Arrangements should be made that there should be berthings open to all the world. The present depth of the harbor is 23 feet. Loading and discharging bulk cargoes, such as coal, is done by means of cranes and derricks, but for the rapid and economical transference, which is most to be desired for New London, there are no facilities. It is of the greatest importance that the piers, wharves, transshipment sheds and warehouses and railroad tracks be laid out with proper reference to each other, and also that they be connected with the railroads.

There are a number of principle factors essential to a good water terminal. First, ample pier, quay and wharf capacity and basins; vessels must not be delayed awaiting a berthing. Second, commodious and high transshipment sheds. Third, as distinct from the transshipment sheds, warehouses and warehouse yard space. Fourth, modern transshipment machinery. Fifth, mechanical connections between the piers, sheds and warehouses. Sixth, rail or water connections between the terminals and the cities of the hinterland.

These water terminals should not be under long lease, but the terminals and piers should be the public servants of the whole port. There should also be private warehouses, as now proposed for New York, but subject to the control of the State as to rates.

There will be ample depth of water, and the wharves should be of sufficient length to accommodate the longest ocean steamers. To secure the best results at a complete terminal there should be included every factor necessary to secure easy freight movements, but all installed under expert advice, and co-ordinated in such a way as to secure the greatest possible rapidity and economy of operation.

The city should do everything in its power to provide paved roads to the terminals, and to reserve wharves which can be occupied by other vessels and freighters besides the regular lines, and everything should be done to make the city of New London an open port where steamships of every nationality can easily and quickly load and discharge. Provided that this is done under engineering direction, and modern improvements added from time to time, it is absolutely safe to predict that the growth of the city will be phenomenal. There have been published valuable figures showing that for every ton of freight which passes through a city a certain amount of money is left in the city. Terminals under proper management can be made self-supporting. In the city of New York it is stated that the terminal charges have not only paid all port expenses but also have produced a handsome surplus of over $100,000,000 (£20,000,000), which it has invested in wharves, piers and dock properties. H. McL. Harding.

New York.

A Correction.

Editor International Marine Engineering:

Regarding the reference to my work by Mr. Barnaby in your August issue, in which he states that I have made the statement that thrusts as high as 16 pounds per square inch of projecting surface have been recorded in turbine propellers giving a fair amount of efficiency, I wish to make a correction.

Mr. Barnaby has taken a wrong meaning from what I intended. My statement was as follows:

"In case of the turbine ships with propellers of low pitch and high speed of rotation, a maximum value of meter thrust to hold 50 percent propulsive efficiency on bare hull appears to be reached at about 16 pounds per square inch of projected area."

I had previously explained in the article, from which this quotation is taken, that by meter thrusts was meant the shaft-horsepower multiplied by 33,000, divided by pitch, times the revolutions, times the projected area of the propeller in square inches, while Mr. Barnaby assumes that the 16 pounds referred to was given as effective thrusts.

Washington, D. C. C. W. Dyson, U. S. N.

In the article on "Electrification of Marine Engineering Work" in our July issue, by an oversight the name of the Shields Engineering & Dry Dock Company, Ltd., was left out.

SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Loan & Trust Building, Washington, D. C.

993,440. ICE-BREAKER. ELOUILD DUPLESSIS, OF SOREL, QUEBEC, CANADA.

Claim.—An ice-breaking boat provided with a projecting prow adapted to extend under the ice and lift and break the same said prow also having laterally extending parts (4) for scraping the ice from wharves and the said ice-breaking boat being further provided with a keel (3), which is deeper in the water than the body of the boat and is located only under said prow and has its bottom line inclined forward, its greatest depth being under the tip of the prow. One claim.

993,402. LIFE PRESERVER. JACOB ELFORREST PRESCOTT, OF PORTLAND, ME.

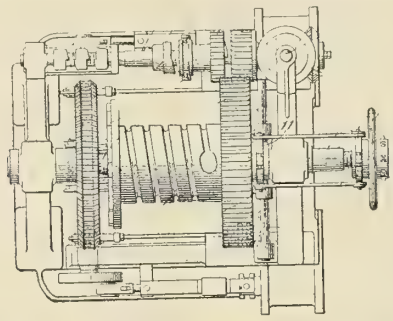
Claim 1.—A life preserver comprising a flexible base, two series of parallel horizontally positioned buoyant elements attached thereto, one series at each side of the base, the two series being parallel and being separated laterally from each other by a wide uncovered portion of the base, a head receiving opening in the base positioned between the two series of buoyant elements, and means for securing the life preserver to the body. Six claims.

994,552. SUBMARINE BOAT. GEORGE B. YERTON, OF NEW YORK, N. Y.

Claim 1.—A life boat for submarine craft, comprising a shell provided with a manhole in the floor of the shell, said shell being adapted to be removably secured to the submarine provided with a manhole in the upper part of the same, a removable and replaceable cover for the said manhole, to enter the said shell from the said submarine, a safety cover adapted to removably close the manhole in the said shell, an annular chamber in the said submarine encircling the manhole of the submarine, and inter-connected gears in the said shell engaging the said chamber for disconnecting the said shell from the said submarine. Three claims.

994,876. COMBINED STEAM AND HAND STEERING ENGINE. FREDERICK C. SCHOEN, OF NEW YORK, N. Y., ASSIGNOR TO LIDGERWOOD MANUFACTURING COMPANY, A CORPORATION OF NEW YORK.

Claim 2.—In combination a drum, a gear on the drum, a hand-power shaft, a gear pinion threaded on said shaft and meshing with the drum



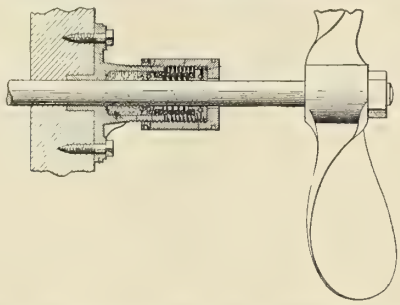
gear, a second pinion on said shaft, and means for placing said drum gear in mesh with said first and second gears simultaneously. Fifteen claims.

994,874. POWER-TRANSMISSION MECHANISM. THEODOR RICHARD RYSZKA, OF KANSAS CITY, KAN.

Claim 1.—In power transmission mechanism, a friction wheel having an annular concentric flange, a smaller friction wheel concentric and rotatable with the other wheel, two laterally flexible rotary shafts, two intermediate friction wheels respectively secured to and rotatable with said shafts and disposed at diametrically opposite sides of the smaller friction wheel between said wheel and said flange, and means for simultaneously laterally shifting said shafts in opposite directions, whereby both intermediate wheels may alternately be brought into driving contact with the other two wheels. Six claims.

994,709. PROPELLER SHAFT STUFFING-BOX. CHARLES B. ADAMS, OF CHARLESTON, S. C., ASSIGNOR OF ONE-HALF TO E. E. WEHMANN, OF CHARLESTON, S. C.

Claim.—In a stuffing box for propeller shafts, the combination with the cylindrical externally threaded packing box for the reception of a



fibrous packing and having a base flange integral therewith for attachment to the stern post of a boat, an integral nipple projecting from said flange opposite to the stuffing box and forming an elongated shaft supporting bearing, and an internally threaded relatively long cap fitting on said box and having a propeller shaft aperture therein of greater diameter than said bearing, of a follower mounted to move longitudinally within the box for compressing the packing therein and fitting the box and shaft with sufficient accuracy to prevent the packing from slipping past the same, an anti-friction thrust bearing co-operating with the outer side of said follower, a bearing ring for the shaft located in the cap whereby entry of dirt into the cap is prevented, an anti-friction thrust bearing co-operating with said ring, and a coil spring interposed between said thrust bearings for compressing the packing, the compression being in the same direction in which the water pressure acts upon the packing.

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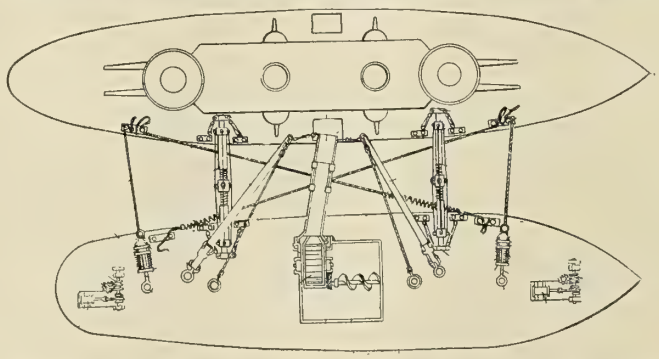
16,430. APPARATUS FOR TRANSFERRING CARGOES TO SHIPS WHILE UNDER WEIGH. C. M. ASKEGREN, PENSACOLA, FLA.

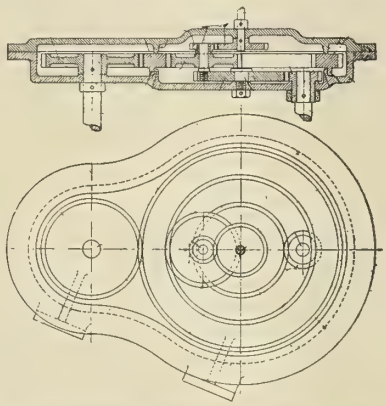
In the lowest part of the hold are spiral conveyers, each receiving motion from a vertical shaft and bevel gear. About midway the length of the vessel is an upright shaft, in which is an endless band conveyer, to which motion is imparted by pulleys on the ends of the spiral conveyers. A chute hinged to the upper end of the shaft can be raised or lowered to deposit the cargo into the hold of an adjacent ship by



means of booms raised and lowered by pulley blocks and cables. During the operation the vessels are connected by cables, the ends of which are attached by spring devices on the deck of the vessel containing the conveyers; the cords passing around belaying pins or pulley blocks on the adjacent vessel, and then back to the other vessel to which it is attached either directly or to a coiled spring on to the deck as a further resiliency to prevent breakage of the cable. Resilient struts keep the vessels the right distance apart.

17,312. SPEED INDICATORS. CHADBURN'S (SHIP) TELEGRAPH COMPANY, LED., AND A. J. GRANT, BOOTLE.

Has reference to telegraphic apparatus in which the relative speeds of two or more revolving shafts is indicated, say the two (or more) driven propeller shafts where it is desirable to keep the relative speeds of the two shafts the same, or at any fixed ratio, or where the mean speed should be indicated and ascertained, or that the same total number of revolutions of the shaft should be made in any given period of time. In this speed indicator the train of wheels between the shafts



which transmit motion to the apparatus, and the indicating spindle, or axis, are of the spur type and arranged in parallel planes; and the two motions are transmitted from the two shafts to a large wheel, which is toothed externally to be geared up directly with the one shaft, and toothed internally to mesh with a "floating" wheel which is carried on an axis adapted to be rotated relatively to or about the center of the large wheel; and the rotation of this wheel about its revolving axis or spindle is transmitted through gearing to the indicator spindle or axis.

3,397. NETS FOR PROTECTION AGAINST TORPEDOES, ETC. VOLTOHMSEIL- UND KABELWERKE AKT. GES., FRANKFURT a/M, GERMANY.

This is a net of wire cords in which each grommet is wound in the shape of a cable from a round wire cord consisting of thin straight wires wound round a central core.

23,266. SHIPS' BERTHS. A. N. CHAMBERLAIN, BIRMINGHAM.

The berth comprises an angle-iron framework in two parts pivoted together, and when these are extended the flexible mattress will accommodate, say, two persons, but when folded so that one part lies upon another it forms a berth suitable for, say, one person. In the latter case a stretcher is turned outward to form a support and stretcher for the outer side of the mattress.